

The taxonomic identity of *Alpheus gracilipes* Stimpson, 1860 (Decapoda: Caridea: Alpheidae), with description of five new cryptic species, from Japan

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Abstract.— The taxonomic identity of *Alpheus gracilipes* is established on the basis of a newly designated neotype from Tahiti. All specimens referred to *A. gracilipes* complex from Japan and some other localities were thoroughly reexamined. As a result, *A. gracilipes* and five new cryptic species, *A. angustilineatus*, n. sp., *A. fujitai*, n. sp., *A. kuroshimensis*, n. sp., *A. parvimaculatus*, n. sp. and *A. roseodigitalis*, n. sp., are recognized and described. Two keys to the seven presently known species of the *A. gracilipes* complex, based on morphological characters and color patterns, respectively, are provided.

Introduction

Alpheus Fabricius, 1798 is by far the largest genus in the family Alpheidae, presently containing more than 250 species worldwide. However, relatively recent studies have demonstrated existence of numerous cryptic species, distinguishable only by subtle morphological characters and/or color in life (Knowlton, 1986; Bruce, 1987, 1994, 1999; Knowlton & Mills, 1992; Anker, 2001). Many of the geographically widespread and morphologically “variable” *Alpheus* species are actually cryptic species complexes. The present study also deals with the species complex around *Alpheus gracilipes* Stimpson, 1860, a relatively common species in shallow coral reef habitats of the Indo-West Pacific (*e.g.*, Miya, 1974; Banner & Banner, 1982; Chace, 1988).

Alpheus gracilipes originally described from Tahiti, French Polynesia (Stimpson, 1860), belongs to the Diadema group, one of the seven groups recognized in the genus *Alpheus* (Banner & Banner, 1982; Chace, 1988). The original description of *A. gracilipes* by Stimpson was very short and superficial for modern standards, and was not accompanied by illustrations. Furthermore, the holotype was possibly destroyed by the Chicago Fire in 1871 (Poupin, 1998). Subsequently, *A. gracilipes* was recorded from various localities in the Indo-Pacific region, from the Red Sea and Madagascar to Japan, Australia, French Polynesia and Hawaii (*e.g.*, Banner, 1953; Tiwari, 1963; Banner & Banner, 1966b, 1982, 1983; Chace, 1988).

Alpheus gracilipes can be distinguished from all other presently known species of *Alpheus* by the combination of the following characters: rostrum almost reaching the distal margin of the first segment of the antennular peduncle; post-rostral area flattened dorsally, abruptly delimited from the orbital hoods by deep adrostral grooves; orbital hoods higher than rostrum, anterior margin unarmed, more or less angular; disto-lateral tooth of scaphocerite exceeding narrow blade; major chela about 3.5 times as long as wide, palm with a distinct transverse groove; minor chela about five times as long as wide, dactylus bearing balaeniceps setae in both sexes; second pereopod with the first carpal segment slightly longer than second; third pereopod with ischium bearing strong spine, merus unarmed, propodus bearing 10–16 spines; dactylus simple, conical; uro-

pod with lateral spine not dark-colored; telson with two pairs of dorsal spines (modified from Chace, 1988; Bruce, 1999).

Some authors pointed out minor differences in morphology (and sometimes color patterns) among *A. gracilipes* from different localities, but attributed these to intraspecific variation (Banner & Banner, 1982). Bruce (1999) was the first, who described a new species, *A. soror* Bruce, 1999, on the basis of these differences. Bruce (1999) compared his new species with specimens of *A. gracilipes* from northern Australia, but not to the type locality. However, Bruce also noted that the *A. gracilipes* complex could contain more undescribed species.

Our study of extensive material of genus *Alpheus* from southern Japan confirmed that several species were confused under the name "*A. gracilipes*", and other some closely related species recognized. These species can be separated from each other by subtle morphological features, and more easily, by color patterns of the living shrimps. In order to establish the taxonomic status of these species, first, the specific identity of *A. gracilipes* is established on the basis of a neotype from the topotypic locality. Second, all specimens referred to *A. gracilipes* complex collected from Japan were thoroughly reexamined. As a result, *A. gracilipes* and five new cryptic species, *A. angustilineatus*, n. sp., *A. fujitai*, n. sp., *A. kuroshimensis*, n. sp., *A. parvimaculatus*, n. sp. and *A. roseodigitalis*, n. sp., are described and illustrated herein. In this study, a total of seven species which added *A. soror* Bruce to above six species are treated as the *A. gracilipes* species complex.

Materials and Methods

Most specimens examined in this study were collected in southern Japan. Additional material from other Indo-West Pacific localities was also examined. For comparative purposes, we also used a moult of a female specimen of *A. soror* (CL 11.6 mm) imported through aquarium trade from Sri Lanka.

Specimens are deposited in the following institutions: Natural History Museum and Institute, Chiba, Japan (CBM); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC); Natural History Museum of the Los Angeles County (LACM); Academia Sinica, Taipei, Taiwan (AS); National Fisheries University, Shimonoseki, Japan (NFU); Sabiura Marine Park Research Station, Kushimoto, Japan (SMP).

The carapace length (CL) was measured in mm from the base of the rostrum to the postero-dorsal margin of the carapace. The total length (TL) was measured in mm from the tip of the rostrum to the posterior margin of the telson. In addition, following measurements were made: length of the major chela palm, measured from the distal margin of the adhesive plaque to the proximal margin of the palm; length of the dactylus of the major chela, measured from the distal margin of the adhesive plaque of the palm to the tip of the dactylus.

Taxonomy

Alpheus gracilipes Stimpson, 1860 (Figs. 1, 2, 13A–B)

Japanese name: Medama-teppouebi

Alpheus gracilipes Stimpson, 1860: 100; Coutière, 1898: 196; Coutière, 1899: 486, fig. 277; Tiwari, 1963: 298, figs. 18–19; Miya, 1974: 154 (part, not pl. 30c); Monod, 1976: 141, figs. 20–25; Odinetz, 1983: 207; Miya, 1984 (part) : 94; Hayashi, 1997, figs. 321d, 323d, 324d, 325d: 124; Liu & Lan, 1980: 93, fig. 8; Poupin, 1998: 19; Miya, 1995: 325, fig. 21-255E.

Crangon gracilipes–Banner, 1953: 115, fig. 41a–i.

Alpheus sp.–Kamezaki *et al.*, 1988: 65, with unnumbered fig. (proposal of new Japanese name).

Alpheus sp. 4 aff. *gracilipes*–Nomura *et al.*, 1996: 11.

? *Alpheus gracilipes*–Heller, 1865: 108; Miers,

1879: 55; De Man, 1888a: 500, pl. 21, fig. 5; De Man, 1888b: 43, fig. 15; Ortmann, 1890: 488; Thallwitz, 1891: 21; Coutière, 1897: 195; Borradaile, 1898: 1013; Coutière, 1900: 414; De Man, 1902: 864; Coutière, 1905: 901; De Man, 1911: 248; Balss, 1914: 38; De Man, 1924: 43; Yokoya, 1933: 22; Barnard, 1950: 744 (key), fig. 140j; Banner, 1957: 204; Banner, 1958: 167; Banner & Banner, 1964: 92; Banner & Banner, 1966a: 179; Banner & Banner, 1966b: 112, fig. 39; Banner & Banner, 1968: 289; McNeill, 1968: 17; Kensley, 1972: 58, fig. 26d; Garth, 1974: 200; Banner & Banner, 1978: 222; Holthuis, 1980: 120; Banner & Banner, 1981: 24; Banner & Banner, 1982: 143, fig. 41; Banner & Banner, 1983: 32; 1984: 38; Nakasone & Yamaguchi, 1987: 90 (list); Chace, 1988: 29; Bruce, 1988: 230; Bruce & Coombes, 1997: 322; Bruce, 1999: 459 (part).

Not *Alpheus gracilipes*—Miers, 1884: 287 (= *A. miersi* Coutière, 1898); Bate, 1888: 561, pl. 101, fig. 3 (not *A. gracilipes* complex); Banner & Banner, 1956: 357; Banner & Banner, 1967: 276; Banner & Banner, 1985: 18 (other species of *A. gracilipes* complex); Kamezaki *et al.*, 1988: 57 with unnumbered fig. (= *A. roseodigitalis* n. sp.); Miyake, 1991, pl. 15-3 (= *A. roseodigitalis* n. sp.); Nomura *et al.*, 1996: 11 (= *A. roseodigitalis* n. sp.); Bruce, 1999: 462, figs. 1B, 4 (other species of *A. gracilipes* complex).

Material examined.—Neotype. Male (CL 7.0), French Polynesia, Tahiti, coral reef, from base of *Pocillopora verrucosa*, 1982, coll. O. Odinetz, MNHN-Na 13661.

Other material. Japan: Yaeyama Islands, southern Ryukyu Archipelago; 1 ovig. female (CL 6.8), Nakamoto, Kuro-shima, under dead coral, depth 3 m, 12 Dec 1986, coll. K. Nomura, SMP (YMP)-362; 1 male (CL 5.7), 1 female (CL 7.0), Iko, Kuro-shima, dead coral crevices, depth 5 m, 27 Nov 1987, coll. K. Nomura, CBM-ZC 6582; 2 males (CL 6.8–7.3), 3 females (CL 5.4–8.5), ovig. female (CL 7.3), same data as for CBM-ZC 6582, SMP (YMP)-780; 1 male (CL 6.4), 1 ovig. female (CL 7.5), Fuki, Kuro-shima, dead coral crevices, depth 2 m, 3 Sep 1998, coll. K. Nomura, NFU 530-2-2578. Okinawa Islands, central Ryukyu Archipelago; 1 male

(CL 5.0), Shimajiri, Kume-jima, depth 1–3 m, 18 Nov 1992, coll. S. Nagai, SMP (YMP)-1223a; 1 ovig. female (CL 7.4), Ginowan Convention Beach, Okinawa-jima, intertidal, 10 Aug 1998, coll. Y. Fujita, MNHN-Na 13660.

Taiwan: 1 male (CL 5.6), Kenting, S Taiwan, reef near shore, dead corals and rocks with living coral, depth 2–3 m, 3–4 Oct 2004, coll. A. Anker *et al.*, AS. Red Sea: 2 ovig. females (CL 8.3–8.6), MNHN Na 2469. New Caledonia: 1 male (CL 4.6), 1 ovig. female (CL 5.7), Nouméa, MNHN-Na 8151. Guam: 1 male (CL 6.4), 1 ovig. female (CL 6.6), MNHN-Na 7063. French Polynesia: 1 male (CL 4.2), 4 ovig. females (CL 4.5–7.4), 3 young individuals (most specimens with rostrum and anterior appendages damaged), same data as for neotype, MNHN-Na 7064. Fiji: 1 juvenile, Yaqara Bay, northern coast of Viti Levu, from dead coral, Jan 2005, coll. A. Anker *et al.*, LACM. Hawaii: 2 ovig. females (CL 6.2–6.4), Honolulu, MNHN-Na 2841.

Redescription.—Carapace (Fig. 1A, B) glabrous. Frontal margin between rostrum and orbital hood slightly indented in dorsal view. Rostrum rather broad, 1.9–3.1 times as long as wide at base dorsally, tip reaching or falling short of distal margin of first segment of antennular peduncle, dorsal margin rounded. Post-rostral area of rostrum abruptly delimited from orbital hood by deep adrostral furrows, dorsal surface flattened, forming with rostrum slender, triangular plate, 1.8–2.3 times as long as wide at base. Orbital hoods inflated, rising above rostrum and post-rostral area; anterior margin unarmed, slightly angular in dorsal view.

Abdominal pleura (Fig. 1C) smooth, rounded, postero-ventral margin of fourth pleuron blunt, that of fifth pleuron angular or subacute. Telson (Fig. 1D) 1.9–2.2 times as long as anterior width; dorsal surface with 2 pairs of moderately strong spines, first pair situated in anterior half to mid-length; posterior margin moderately convex with 2 pairs of spines at postero-lateral angles, mesial spines 2.5–3.8 times as long as lateral.

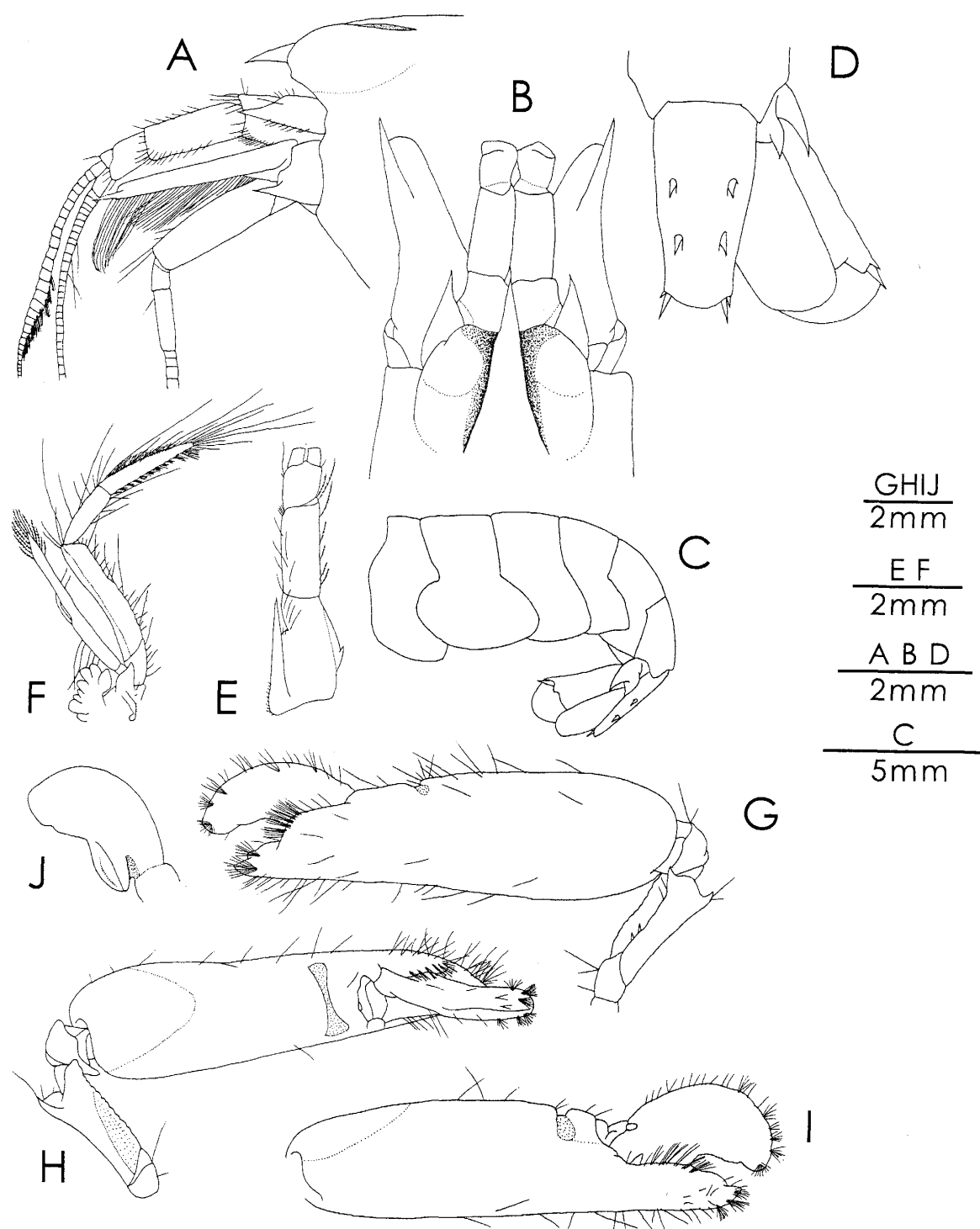


Fig. 1. *Alpheus gracilipes* Stimpson, A, C, E-J, neotype, MNHN-Na 13661, male (CL 7.0); B, MNHN-Na 13660, ovig. female (CL 7.4); D, MNHN-Na 7064, ovig. female (CL 7.4): A, anterior carapace and cephalic appendages, lateral; B, same, dorsal; C, abdomen, lateral; D, telson and right uropod, dorsal; E, right antennular peduncle, ventro-lateral; F, left third maxilliped, mesial; G, right (major) cheliped, mesial; H, same, dorsal (merus and ischium, lateral); I, same, chela, lateral; J, same, dactylus, mesial.

Antennular peduncle (Fig. 1A, B, E) reaching nearly to distal margin of blade of scaphocerite; first segment with small tooth on ventro-mesial carina; stylocerite distally acute, slightly shorter than to slightly overreaching distal margin; second segment 2.1–2.6 times as long as wide at mid-length and 1.4–2.1 times as long as visible part of first segment. Lateral flagellum (Fig. 1B) biramous; shorter branch composed of 2–3 segments with aesthetascs; proximal fused portion composed of 12–22 segments, distal 4–8 bearing aesthetascs.

Antenna (Fig. 1A, 1B) with basicerite bearing moderately strong ventro-lateral tooth. Carpocerite reaching from distal margin of second segment to distal margin of third segment of antennular peduncle. Scaphocerite with strong disto-lateral tooth, reaching far beyond third segment of antennular peduncle; blade rather narrow, 2.4–2.8 times as long as maximum width.

Mouthparts typical for genus. Third maxilliped (Fig. 1F) slender; ultimate segment 5.0–6.7 times as long as wide at base, distally tapering; exopod exceeding distal margin of antepenultimate segment; coxa with distally acute lateral plate.

Major cheliped (Fig. 1G–J) with chela 3.5–4.5 times as long as maximum width, slightly compressed. Dactylus 0.5–0.6 times as long as palm, compressed, somewhat twisted in dorsal view, tip rounded; plunger relatively small, semi-triangular. Pollex with broad base, tip blunt, crossing with tip of dactylus. Palm 2.3–2.7 times as long as proximal width; dorsal surface with broad transverse groove near dactylar articulation extending to lateral and mesial side by broad depressions, lateral depressions oval, larger than mesial depressions, proximal shoulder slightly or not overhanging transverse groove; ventral margin smooth, without sculpture. Carpus short, cup-shaped. Merus 2.0–2.9 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 2–3 movable spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal mar-

gin armed with acute distal tooth; lateral surface slightly depressed near ventral side.

General shape of minor cheliped (Fig. 2A–D) similar in male and female. Chela slightly compressed, 4.6–5.9 times as long as maximum width. Fingers with tips acute, crossing, cutting edges sharp. Dactylus 0.7–0.9 times as long as palm with moderately developed balaeniceps setae in both sexes. Pollex with row of plumose setae on lateral and mesial surface in males, on lateral surface only in females. Palm 2.7–3.4 times as long as maximum width, dorso-mesial margin with blunt subtriangular tooth flanking dactylar articulation. Carpus short, cup-shaped, almost as long as wide. Merus 3.3–4.3 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 3–4 spines; ventro-lateral margin slightly protruding, distally unarmed; dorsal margin with acute distal tooth; lateral surface with slight depression proximal to ventral margin.

Second pereopod (Fig. 2E) with chela 3.2–4.1 times as long as maximum width; fingers subequal in length to palm, tips crossing, cutting edges sharp; carpus subdivided into 5 segments, second segment 0.67–0.84 times as long as first.

Third pereopod (Fig. 2F) with dactylus simple, slightly curved, 4.0–5.5 times as long as wide at base; propodus slightly shorter than merus, ventral margin with 9–14 spines, arranged in double row on anterior third; carpus 0.6 times as long as propodus; merus 6.3–7.7 times as long as maximum width, unarmed; ischium 0.4 times as long as merus, ventral surface bearing 1 spine. Fourth pereopod (Fig. 2G) similar to third pereopod, slightly shorter; ventral margin of propodus with 12–15 spines; ischium with 1 spine on ventral surface. Fifth pereopod (Fig. 2H) as long as third pereopod; ventral surface of propodus with about 10 spines and 10 rows of tufts of short setae; ischium usually unarmed, occasionally with small spine.

Uropod (Fig. 1D) overreaching posterior

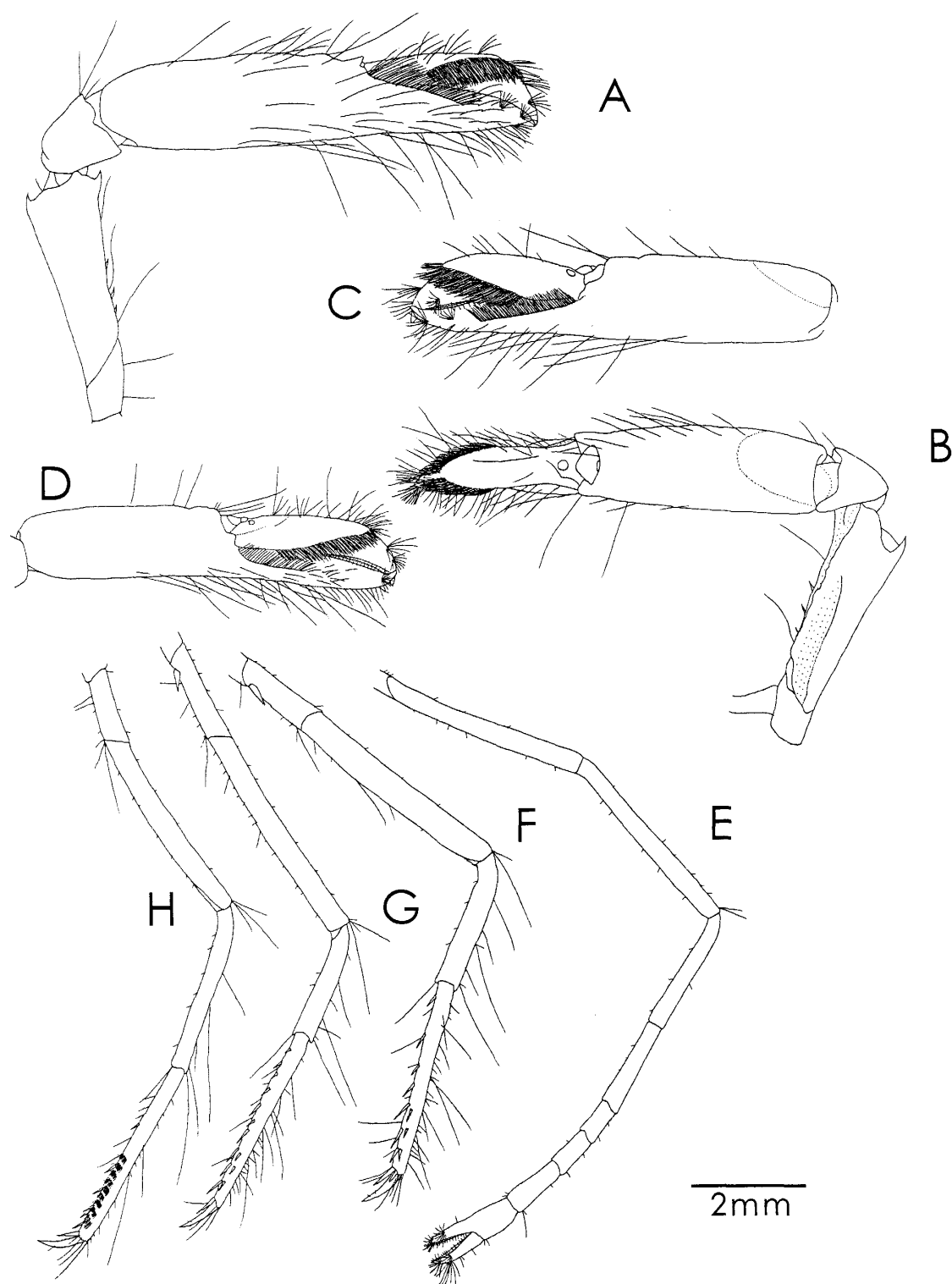


Fig. 2. *Alpheus gracilipes* Stimpson, A–C, E, neotype, MNHN-Na 13661, male (CL 7.0); D, F–H, MNHN-Na 7064, ovig. female (CL 7.4): A, left (minor) cheliped, mesial; B, same, dorsal (merus and ischium, lateral); C, same, chela, lateral; D, minor chela, lateral; E, right second pereopod, lateral; F, right third pereopod, lateral; G, right fourth pereopod, lateral; H, right fifth pereopod, lateral.

margin of telson; protopod with 2 acute postero-dorsal processes; exopod longer than endopod, diaeresis sinuous, lateral margin with acute subdistal tooth and large spine.

Coloration.—Ground color chocolate to chestnut brown; carapace with whitish irregular patches, especially on flanks; abdomen with whitish, narrow, longitudinal stripes on dorsal side, continuing on at least 2 first pleura, lateral side of second and fourth pleura each with very conspicuous black spot, first spot much larger and forming ocellus bordered by narrow whitish circle; antennal flagella bluish; chelipeds dark-orange to brown, with darker areas close to finger bases, distal portion of dactylus of major chela whitish, with tips of fingers usually pale or whitish; second to fifth pereopods bluish or purplish; tail fan brown with whitish spots, posterior area of tail fan and diaeresis bluish (Figs. 13A, B).

Size.—Medium-sized species for *A. gracilipes* complex, with largest male measuring 7.3 mm CL; largest female 8.6 mm CL, about 25 mm TL.

Habitat.—The neotype specimen was collected from the base of a coral colony, *Pocillopora verrucosa*, on a shallow coral reef. The type specimen of *A. gracilipes* was also collected among corals in 2 m deep water (Stimpson, 1860). Japanese specimens were found mainly under large dead coral or in coral crevices, from the intertidal down to about 5 m deep.

Distribution.—Widely distributed in the Indo-West Pacific from the Red Sea to Japan and Hawaii: Tahiti, French Polynesia (type locality), Red Sea, Djibouti, Vietnam, southern China, southern Japan, Guam, Kiribati, New Caledonia, Fiji, Hawaii (Stimpson, 1860; Coutière, 1899; Banner, 1953; Tiwari, 1963; Monod, 1976; Liu & Lan, 1980; Hayashi, 1997; present study).

Remarks.—As mentioned at the introduction of this paper, it is unable to recognize the taxonomic identity of *Alpheus gracilipes* from the original description and type material. Therefore, the designation of the neotype of this species was really required prior

to the revision of this species complex. We found out a number of specimens identified as *A. gracilipes* which were collected at the topotypic locality by Olga Odinetz in the Muséum National d'Histoire Naturelle, Paris. All these specimens belonged to the same species which agreed with the present definition of *A. gracilipes* (see introduction), and only topotypic material was available for authors. Although these specimens did not completely agree with the original description (e.g., the proportion of the major chela and the number of spines of merus in posterior pereopods), we selected a large male as a neotype of *A. gracilipes* from the samples for the revision of this species complex.

The examined specimens from Japan, Red Sea, New Caledonia, Guam and Hawaii agree well with the neotype of *A. gracilipes*. Since the original description of *A. gracilipes*, this species was reported from many localities in the Indo-West Pacific (see synonymy). However, only few of these records, especially in older literature, contain detailed descriptions, and even fewer have illustrations or information on color pattern, necessary to confirm the species identification. The following records are referable to *A. gracilipes*: Coutière (1898) from Djibouti; Banner (1953) from Hawaii (as *Crangon gracilipes*); Monod (1976) from New Caledonia; Tiwari (1963) from Vietnam; Liu & Lan (1980) from Xisha Islands, South China Sea; Kamezaki *et al* (1988) from the Ryukyu Archipelago (as *Alpheus* sp.); Nomura *et al* (1996) from the Ryukyu Archipelago (as *Alpheus* sp. 4 aff. *gracilipes*); Hayashi (1997) from Kiribati. Miya's (1974, 1984) records from the Ryukyu Archipelago and Micronesia refer to several species, including *A. gracilipes*.

Records of *A. gracilipes* by De Man (1911, 1924) from Indonesia, and Banner & Banner (1982) and Bruce (1999) from Australia, are more problematical. The descriptions by these authors are not sufficient to positively confirm the identification of this material. The records of *A. gracilipes* by Banner (1956) from the Mariana

Archipelago, and Banner & Banner (1966b, 1967) from Thailand and the Society Islands, most probably refer not to *A. gracilipes* s. str. In these specimens, the minor chela was lacking complete balaeniceps setae in females or in both sexes, whereas in *A. gracilipes*, the minor chela has complete balaeniceps setae in both sexes. The material from the Ryukyu Archipelago reported as *A. gracilipes* more recently (Kamezaki *et al.*, 1988; Miyake, 1991; Nomura *et al.*, 1996) was reidentified as *A. roseodigitalis*, n. sp. (see below).

***Alpheus angustilineatus*, new species**
(Figs. 3, 4, 13C–D)

New Japanese name: Komedama-teppouebi

Material examined.—Holotype. Male (CL 5.3), Fuki, Kuro-shima, Yaeyama Islands, southern Ryukyu Archipelago, Japan, dead coral crevices, depth 3 m, 21 May 1988, coll. K. Nomura, MNHN-Na 13760.

Paratypes. Female (CL 5.5), same data of holotype, MNHN-Na 13694; 1 male (CL 7.6), 1 ovig. female (CL 8.5), Komi, Iriomote-jima, Yaeyama Islands, dead coral crevices, depth 10 m, 20 Jun 1987, coll. K. Nomura, CBM-ZC 6586; 1 male (CL 10.8), 1 female (CL 8.7), Aka-jima, Okinawa Islands, central Ryukyu Archipelago, tank of Akajima Marine Science Laboratory, 28 May 1997, coll. K. Hashizume, NFU 530-2-2582.

Other material. Fiji: 1 male (CL 17.1), Nasilau Point, Yaqara Bay, northern coast of Viti Levu, from base of dead, algae-overgrown colony of *Acropora*, depth 0.5 m, 24 Jan 2005, coll. A. Anker, LACM CR 2005-005.1. New Caledonia: 1 ovig. female (CL 10.3), MNHN-Na 3484.

Description.—Carapace (Figs. 3A–B, 4E) glabrous, frontal margin between rostrum and orbital hood slightly indented in dorsal view. Rostrum relatively slender, 2.4–4.0 times as long as wide at base, tip reaching proximal margin to mid-length of second segment of antennular peduncle. Post-rostral

area of rostrum abruptly delimited from orbital hoods by deep adrostral furrows, forming with rostrum triangular plate; triangular plate 1.8–2.1 times as long as wide at base, dorsal surface shallowly concave, medio-dorsal area posterior to triangular plate often with minute tubercle. Orbital hoods moderately inflated, lower or higher than rostrum and post-rostral area; antero-dorsal margin bluntly angular.

Abdominal pleura (Fig. 3C) smooth, rounded; postero-ventral margin of fourth pleuron blunt, that of fifth pleuron subacute. Telson (Fig. 3D) 1.9–2.1 times as long as anterior width; dorsal surface with 2 pairs of strong spines; posterior margin moderately convex; postero-lateral angles with 2 pairs of spines, mesial spine 2.5–4.5 times longer than lateral.

Antennular peduncle (Fig. 3A, B, E) usually reaching distal margin of scaphocerite blade; first segment with small tooth on mesio-ventral carina; stylocerite distally acute, reaching or slightly overreaching distal margin of first segment; second segment slender, 2.3–3.0 times as long as central width, 1.4–1.7 times as long as visible part of first segment. Lateral flagellum biramous; shorter branch composed of 2–3 segments bearing aesthetascs; proximal fused portion composed of 15–25 segments, distal 3–7 bearing aesthetascs.

Antenna (Fig. 3B) with basicerite bearing strong ventro-lateral tooth; carpocerite usually reaching distal margin of second segment of antennular peduncle; scaphocerite with strong disto-lateral tooth, reaching far beyond third segment of antennular peduncle, blade narrow, 2.6–2.8 times as long as maximum width.

Third maxilliped (Fig. 3F) slender; ultimate segment 5.7–6.7 times as long as proximal width, tapering distally; exopod exceeding distal margin of antepenultimate segment.

Major cheliped (Fig. 3G–J) with chela 3.6–4.0 times as long as maximum width, slightly compressed. Dactylus about half as long as palm, compressed, somewhat twist-

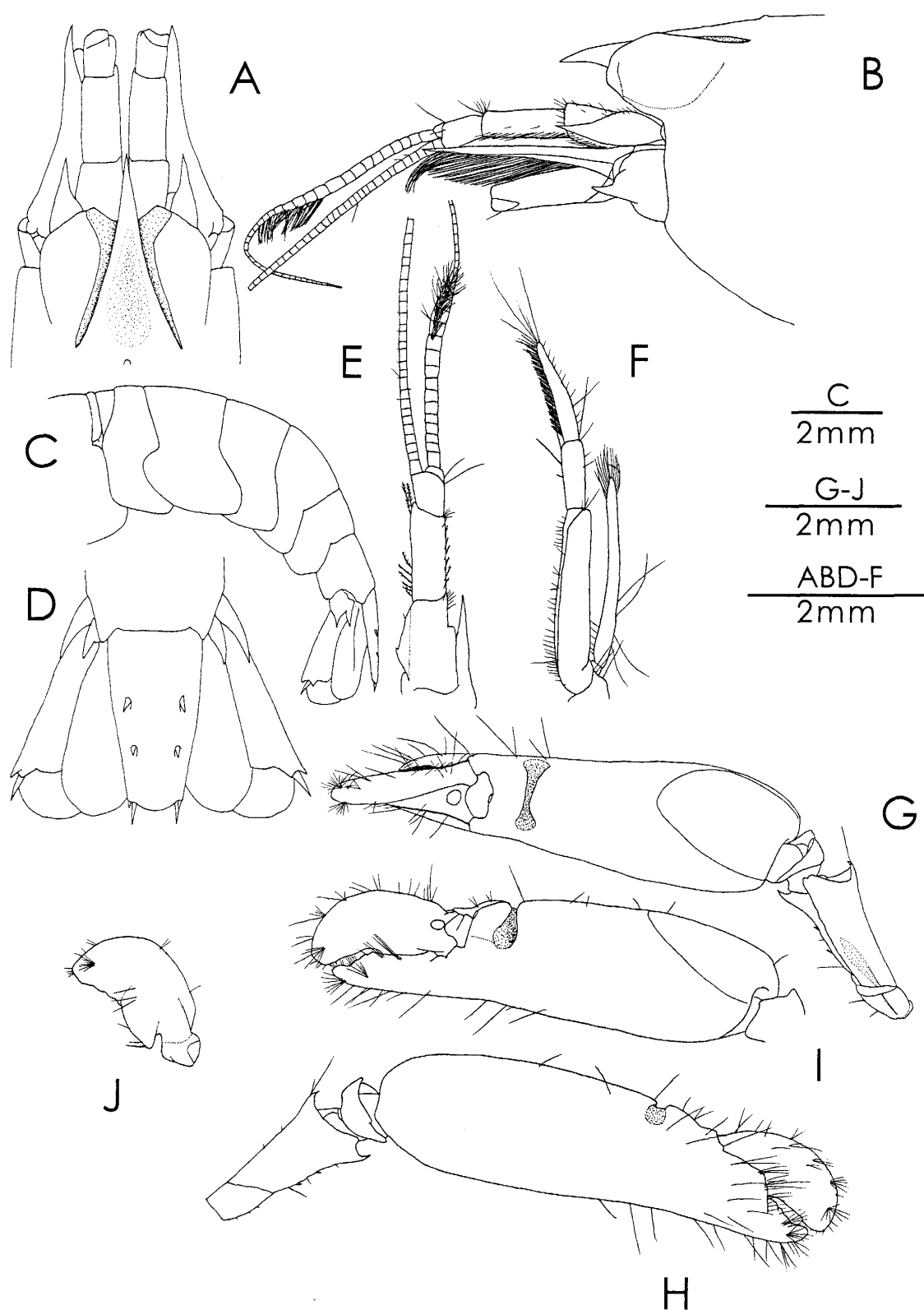


Fig. 3. *Alpheus angustilineatus*, new species, holotype, MNHN-Na 13760, male (CL 5.3): A, anterior carapace and cephalic appendages, dorsal; B, same, lateral; C, abdomen, lateral; D, telson and uropods, dorsal; E, left antennule, ventro-lateral; F, left third maxilliped, mesial; G, left (major) cheliped, dorsal (merus and ischium, lateral); H, same, mesial; I, same, chela, lateral; J, same, dactylus, lateral.

ed in dorsal view, tip rounded; plunger relatively small, semi-triangular. Pollex with broad base, tip blunt, crossing with tip of dactylus. Palm 2.4–2.8 times as long as proximal width; dorsal surface with broad transverse groove near dactylar articulation extending to lateral and mesial side by broad depressions, lateral depressions oval, larger than mesial depressions, proximal shoulder small, slightly overhanging transverse groove; ventral margin smooth, without sculpture. Carpus short, cup-shaped. Merus 2.2–3.0 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 2–3 spines; ventro-lateral margin slightly protruding, distally unarmed; dorsal margin with acute distal tooth; lateral surface depressed proximal to ventral side.

General shape of minor cheliped (Fig. 4A, B, F) similar in male and female. Chela slightly compressed, 4.8–6.0 times as long as maximum width. Fingers with tips acute, crossing distally, cutting edges sharp. Dactylus 0.7–0.8 times as long as palm, with moderately developed balaeniceps setae in both sexes. Pollex with row of plumose setae on lateral and mesial surface in males, on lateral surface only in females. Palm 3.0–3.4 times as long as maximum width, dorso-mesial margin with blunt subtriangular tooth flanking dactylar articulation. Carpus short, cup-shaped, 1.1–1.3 times as long as wide. Merus 4.0–4.8 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 2–3 spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal margin with acute distal tooth, lateral surface with depression proximal to ventral side.

Second pereopod (Fig. 4C) with chela 3.5–4.3 times as long as maximum width; fingers slightly longer than palm, tips crossing, cutting edges sharp; second segment of carpus about 0.7 times as long as first.

Third pereopod (Fig. 4G) with dactylus simple, slightly curved, 4–6 times as long as wide at base; propodus slightly shorter than

merus, ventral margin with 10–12 spines, arranged in double row on anterior third; merus 6.7–8.3 times as long as maximum width, unarmed; ischium 0.4 times as long as merus, ventral surface with 1 spine. Fourth pereopod (Fig. 4H) similar to third pereopod in shape, slightly shorter; ventral margin of propodus with 12–15 spines; ischium with 1 spine on ventral surface. Fifth pereopod (Fig. 4I) as long as third pereopod; ventral surface of propodus with about 12 spines and 15 rows of tufts of short setae; ischium usually unarmed, occasionally with 1 small spine.

Coloration.—Ground color brown; carapace with elongated whitish patches and streaks; abdomen with whitish, narrow, longitudinal stripes, dorsal stripes continuing on at least two first pleura, lateral sides of first to fourth pleura each with small black spot, spot on second pleura not forming large ocellus; chelipeds dark brown, mesial surface of palm of chelae with whitish patches, dactylus of major chela with whitish tip, merus and carpus brown with whitish areas; second pereopods yellowish distally; third to fifth pereopods purplish grey; tail fan mottled with grey-blue, brown and white, setae golden-brown (Fig. 13C, D).

Size.—Medium-sized species within *A. gracilipes* complex, largest male measuring 10.8 mm CL, about 35 mm TL; largest female 10.3 mm CL.

Habitat.—Japanese specimens were collected from crevices of large dead coral at depths of 3–10 m. The Fijian specimen was collected from base of a partly overgrown coral, *Acropora* sp., in 0.5 m deep water.

Distribution.—Distributed in the West Pacific: southern Japan (type locality), New Caledonia and Fiji (present study).

Etymology.—The specific name is a combination of Latin words “angustus” (narrow) and “linea” (line), in reference to the characteristic, narrow, longitudinal whitish stripes on the dorsal surface of the abdomen.

Remarks.—The new species is most similar in morphology and coloration to *A. gracilipes*, with which it was probably often con-

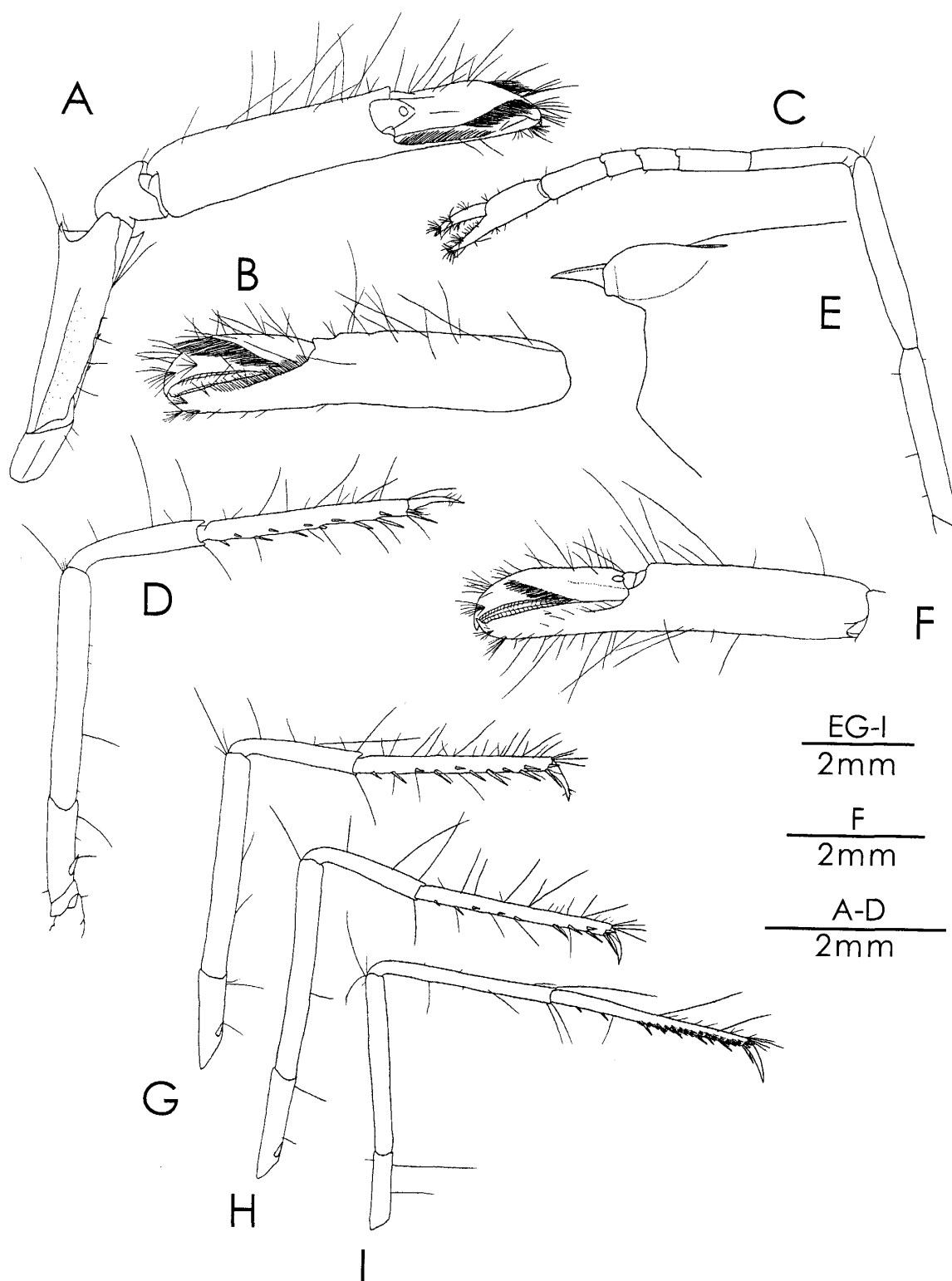


Fig. 4. *Alpheus angustilineatus*, new species, A-D, holotype, MNHN-Na 13760, male (CL 5.3); E-I, paratype, CBM-ZC 6586, ovig. female (CL 8.5): A, right (minor) cheliped, dorso-lateral; B, same, chela, mesial; C, left second pereopod, lateral; D, right third pereopod; E, anterior carapace, lateral; F, left (minor) chela, lateral; G, right third pereopod, lateral; H, right fourth pereopod, lateral; I, right fifth pereopod, lateral.

fused in the past; this especially concerns records from the Western Pacific.

Alpheus fujitai, new species

(Figs. 5, 6, 13E–F)

New Japanese name: Fujita-ashiboso-teppouebi

Material examined.—Holotype. Male (CL 17.4), Mizugama, Kadena, Okinawa-jima, Okinawa Islands, central Ryukyu Archipelago, Japan, submarine cave, depth 5–8 m, by night, 22 May 1998, coll. Y. Fujita, MNHN-Na 13644.

Paratypes. 1 female (CL 19.8), same data as for holotype, NFU 530-2-2577; 1 female (CL 18.4), same locality and habitat as for holotype, 23 Jun 1998, coll. Y. Fujita, CBMZC 6581; 1 female (CL 9.5), same locality and habitat as for holotype, 4 May 2002, coll. Y. Fujita, MNHN-Na 13645; 1 female (CL 7.7), same locality and habitat as for holotype, 5 May 2002, coll. Y. Fujita, SMP (YMP)-2533.

Description.—Carapace (Fig. 5A, B) glabrous. Rostrum slender, 3.4–4.7 times as long as wide at base, tip reaching 1/3 to mid-length of second segment of antennular peduncle, dorsal surface flattened. Post-rostral area of rostrum abruptly delimited from orbital hoods by deep adrostral furrows, dorsal surface with shallow median depression, forming with rostrum slender triangular plate; triangular plate 1.6–2.5 times as long as wide at base. Orbital hoods moderately inflated, lower than rostrum and post-rostral plate, anterior margin slightly angular.

Abdominal pleura (Fig. 5C) smooth, rounded, postero-ventral margin of fourth pleuron blunt, that of fifth pleuron pointed. Telson (Fig. 5D) 1.9–2.2 times as long as anterior width; dorsal surface with 2 pairs of relatively small spines, first pair arising slightly anterior to mid-length; posterior margin somewhat convex with 2 pairs of spines at postero-lateral angles, mesial spine 2.4–3.4 times as long as lateral.

Antennular peduncle (Fig. 5A, B, E) overreaching distal margin of scaphocerite blade; first segment with minute tooth on mesio-ventral carina; stylocerite distally acute, elongate, reaching or slightly overreaching tip of rostrum and reaching to 1/3 of second segment; second segment 1.9–2.0 times as long as wide at mid-length and 1.2–1.4 times as long as visible part of first segment. Lateral flagellum biramous, shorter branch composed of 3 segments bearing aesthetascs; proximal fused portion composed of 19–45 segments, distal 7–19 with aesthetascs.

Antenna (Fig. 5A, B) with basicerite bearing strong ventro-lateral tooth, latter nearly reaching distal margin of first segment of antennular peduncle; carpocerite reaching to distal margin of second segment of antennular peduncle; scaphocerite with strong disto-lateral tooth, slightly overreaching third segment of antennular peduncle; blade 2.2–2.6 times as long as maximum width.

Third maxilliped (Fig. 5F) slender; ultimate segment 6.0–7.7 times as long as proximal width, tapering distally; exopod reaching to distal margin of antepenultimate segment.

All pereopods very slender. Major cheliped (Fig. 5G–I) with chela 5.3–6.3 times as long as maximum width, slightly compressed. Dactylus 0.5–0.6 times as long as palm, compressed, somewhat twisted in dorsal view, tip rounded; plunger rather small, semi-triangular, distally truncate. Palm 3.1–4.1 times as long as maximum width; dorsal surface with narrow transverse groove near dactylar articulation extending to lateral and mesial side by depressions, proximal shoulder small, rounded, not overhanging transverse groove; ventral margin smooth. Carpus short, cup-shaped. Merus 2.9–3.9 times as long as distal width; ventral surface shallowly excavated, ventro-mesial margin with acute distal tooth and 3–4 spines, ventro-lateral margin slightly protuberant, distally blunt to subacute; dorsal margin with acute distal tooth; lateral surface with depression near ventral side.

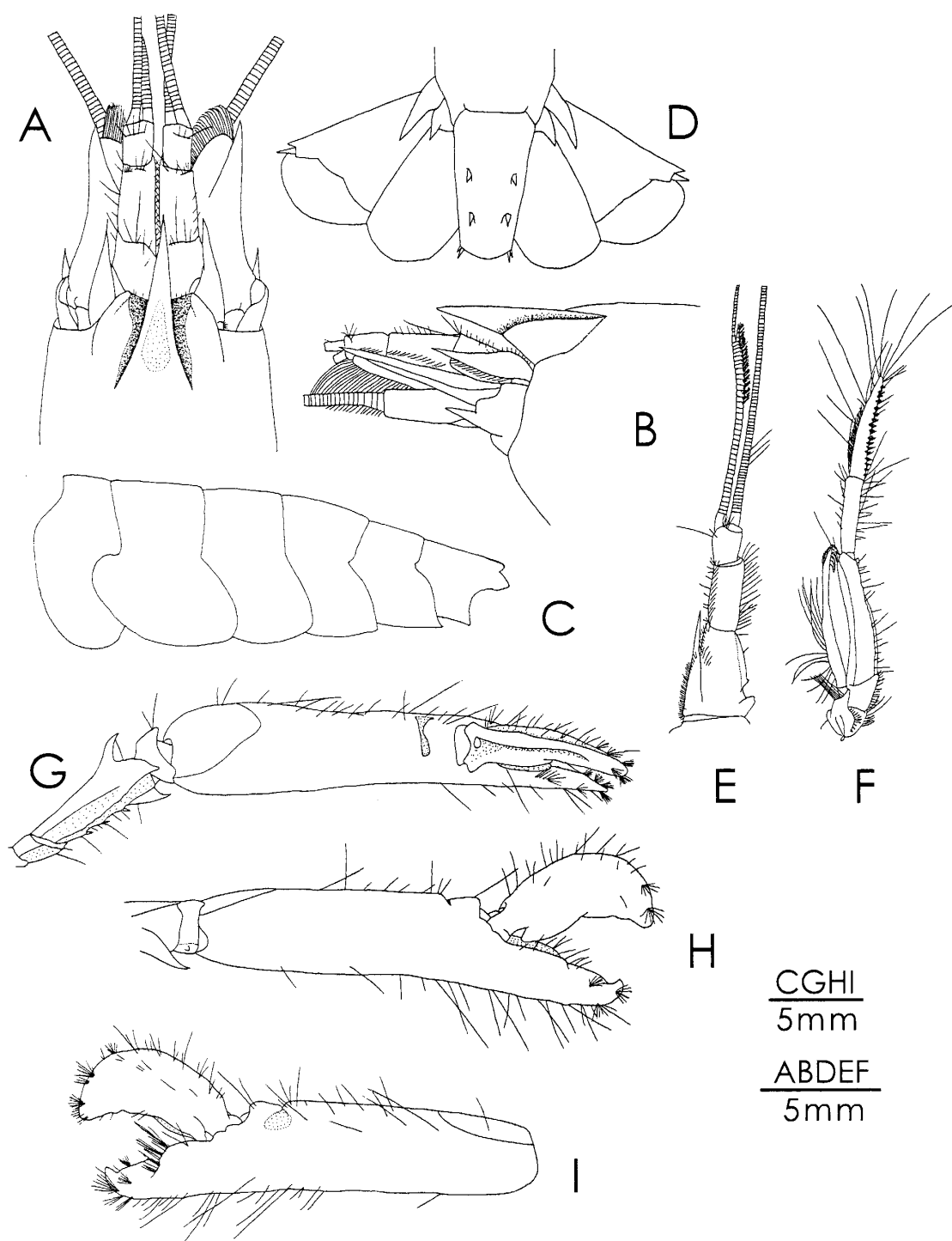


Fig. 5. *Alpheus fujitai*, new species, holotype, MNHN-Na 13644, male (CL 17.4): A, anterior carapace and cephalic appendages, dorsal; B, same, lateral; C, abdomen, lateral; D, telson and uropods, dorsal; E, right antennule, ventro-lateral; F, left third maxilliped, mesial; G, right (major) cheliped, dorsal (merus and ischium, lateral); H, same, chela, lateral; I, same, mesial.

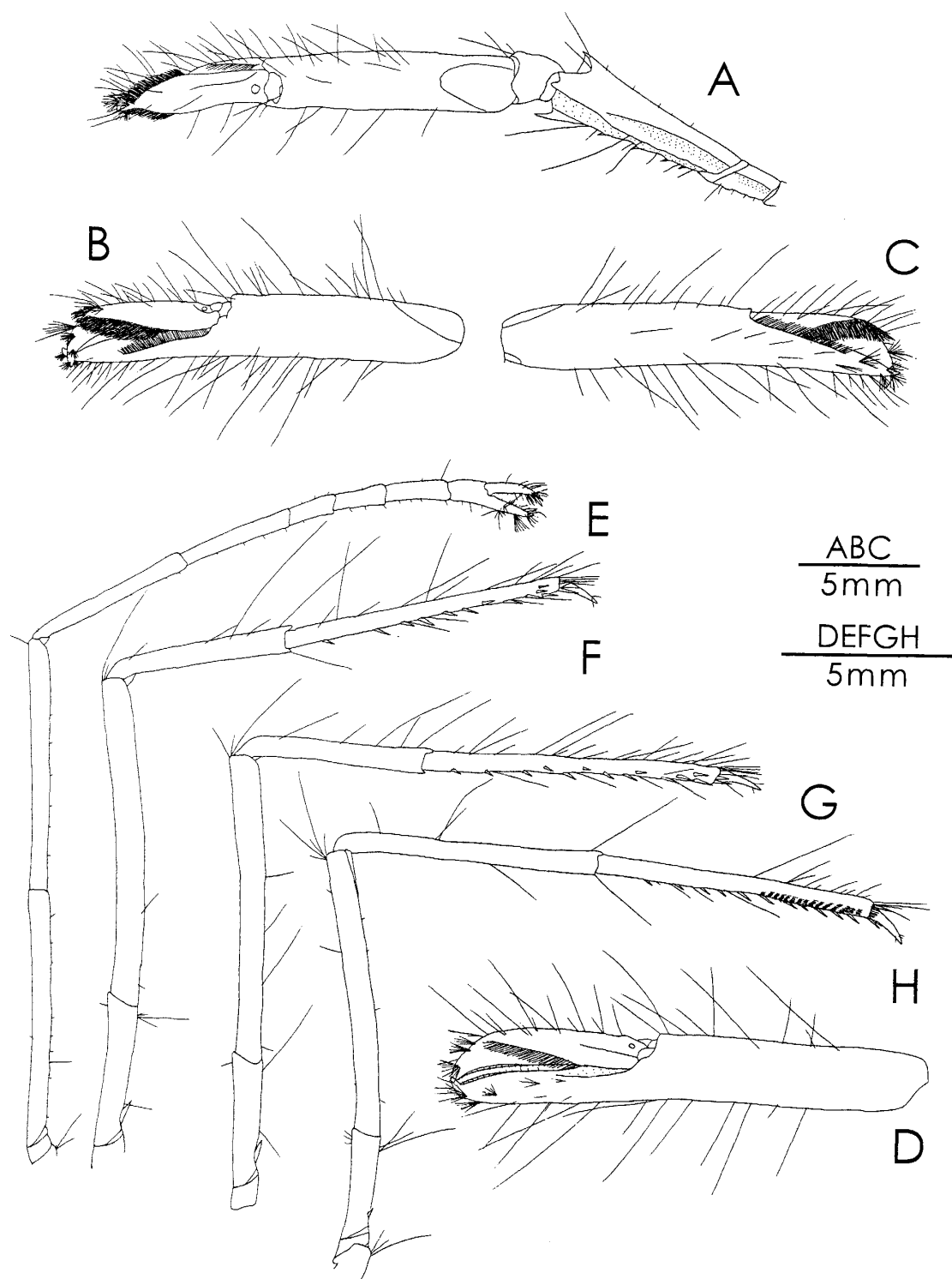


Fig. 6. *Alpheus fujitai*, new species, A–C, E–H, holotype, MNHN-Na 13644, male (CL 17.4); D, paratype, CBM-ZC 6581, female (CL 18.4): A, left (minor) cheliped, dorsal (merus and ischium, lateral); B, same, chela, lateral; C, same, mesial; D, left (minor) chela, lateral; E, right second pereopod, lateral; F, right third pereopod, lateral; G, right fourth pereopod, lateral; H, right fifth pereopod, lateral.

Minor cheliped showing slight sexual dimorphism. Male minor chela (Fig. 6A–C) 6.0 times as long as maximum width, slightly compressed; fingers with tips acute, crossing, cutting edges sharp. Dactylus 0.7 times as long as palm with moderately developed balaeniceps setae. Pollex with row of plumose setae on mesial and lateral surface. Palm 3.8 times as long as maximum width, dorso-mesial margin with blunt subtriangular tooth flanking dactylar articulation. Carpus cup-shaped, as long as wide. Merus 3.1 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 4 spines; ventro-lateral margin protuberant, distally blunt; dorsal margin ending in acute distal tooth; lateral surface with depression proximal to ventral side. Female minor chela (Fig. 6D) 7.0–8.3 times as long as maximum width; dactylus 0.7–0.8 times as long as palm, with weakly developed balaeniceps setae; pollex without row of plumose setae on lateral or mesial surface; palm 3.8–4.4 times as long as maximum width; carpus cup-shaped, longer than in male, 1.3–1.6 times as long as wide; other characters as in male.

Second pereopod (Fig. 6E) with chela 3.3–3.7 times as long as maximum width; fingers about 1.5 times as long as palm, tips crossing, cutting edges sharp; second segment of carpus 0.64–0.78 times as long as first.

Third pereopod (Fig. 6F) with dactylus simple, slightly curved, 3.5–5.2 times as long as wide at base; propodus slightly shorter than merus, ventral margin with 11–18 spines; merus 11.0–12.5 times as long as maximum width, unarmed; ischium 0.4 times as long as merus, armed with 1 spine on ventral margin. Fourth pereopod (Fig. 6G) similar to third pereopod in shape, slightly shorter; ventral margin of propodus with 15–17 spines; ischium with 1 spine on ventral margin. Fifth pereopod (Fig. 6H) as long as third pereopod in length; ventral margin of propodus with 11–25 spines and 12–18 rows of tufts of short setae; ischium with small spine or unarmed.

Coloration.—Carapace and abdomen uniform brown to dark-brown, with greyish tinge, without particular pattern; first and second pereopods, especially major and minor chela orange; walking legs slightly pinkish; telson brownish grey, with pale medio-dorsal area; uropods brownish, bluish posteriorly to diuresis, fringing setae golden yellowish (Fig. 13E, F).

Size.—Large-sized species within *A. gracilipes* complex, with male measuring 17.4 mm CL; largest female 19.8 mm CL, about 50 mm TL.

Habitat.—All specimens were collected at night in submarine caves near the reef shore, in depths ranging from 5 to 8 m.

Distribution.—So far known only from the type locality, Kadena, Okinawa-jima, central Ryukyu Archipelago, Japan.

Etymology.—This species is named in honour of its collector, Dr. Yoshihisa Fujita, University of the Ryukyus, Okinawa.

***Alpheus kuroshimensis*, new species**
(Figs. 7, 8, 13G–H)

New Japanese name: Kuroshima-ashiboso-teppouebi

Material examined.—Holotype. Female (CL 6.1), Cyan, Kuro-shima, Yaeyama Islands, southern Ryukyu Archipelago, Japan, under dead coral rubble, outer reef, depth 10 m, 11 Aug 1998, coll. K. Nomura, MNHN-Na 13689.

Paratypes. 1 male (CL 4.5), same locality and habitat as for holotype, 10 Oct 1999, coll. K. Nomura, CBM-ZC 6583; 1 female (CL 5.1), same data as for CBM-ZC 6583, NFU 530-2-2579.

Description.—Carapace (Fig. 7A, B) glabrous, frontal margin between rostrum and orbital hood slightly indented in dorsal view. Rostrum slender, 3.6–4.2 times as long as wide at base, tip almost reaching 1/5 of second segment of antennular peduncle, dorsal surface rounded. Post-rostral area abruptly delimited from orbital hoods by

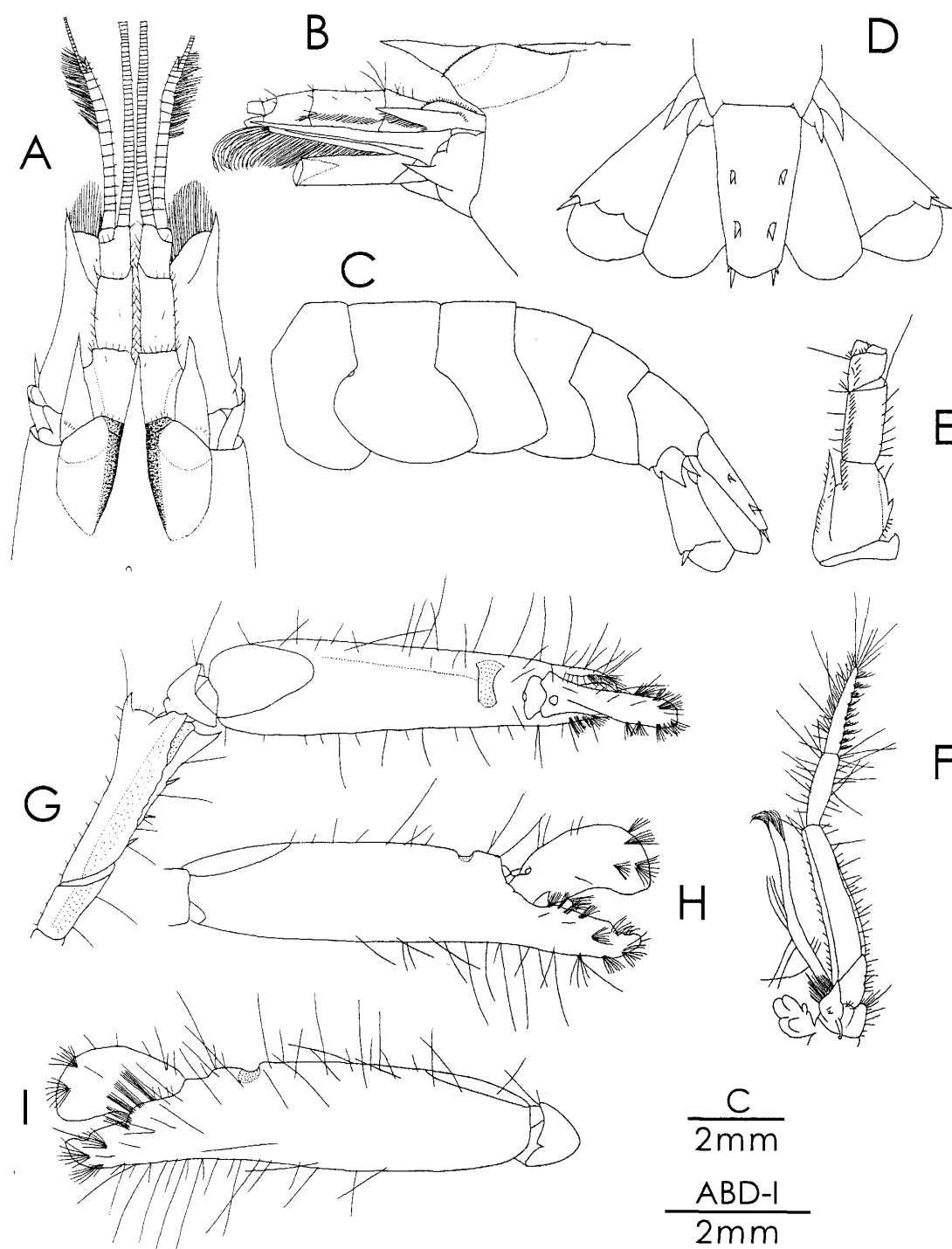


Fig. 7. *Alpheus kuroshimensis*, new species, holotype, MNHN-Na 13689, female (CL 6.1): A, anterior carapace and cephalic appendages, dorsal; B, same, lateral; C, abdomen, lateral; D, telson and uropods, dorsal; E, right antennular peduncle, ventro-lateral; F, left third maxilliped, mesial; G, right (major) cheliped, dorsal (merus and ischium, lateral); H, same, chela, lateral; I, same, mesial.

deep adrostral groove, dorsally flattened, forming with rostrum slender, triangular plate; triangular plate 2.3–2.5 times as long as wide at base. Orbital hoods large, inflated, higher than or as high as rostrum and post-rostral area; anterior margin slightly angular in dorsal view.

Abdominal pleura (Fig. 7C) smooth, rounded; postero-ventral margin of fourth pleuron rounded, that of fifth pleuron blunt. Telson (Fig. 7D) 1.7–2.1 times as long as anterior width; dorsal surface with 2 pairs of moderately strong spines, first pair situated anterior to mid-length; posterior margin moderately convex, with 2 pairs of spines at postero-lateral angles, mesial spines 2.9–3.2 times as long as lateral.

Antennular peduncle (Fig. 7A, B, E) slightly exceeding distal margin of scaphocerite; first segment with small tooth on mesio-ventral carina; stylocerite distally acute, reaching $1/5$ of second segment; second segment 1.4–1.9 times as long as wide at mid-length, subequal in length to visible part of first segment. Lateral flagellum biramous; shorter branch composed of 3 segments with aesthetascs; proximal fused portion composed of 11–15 segments, distal 6–8 bearing aesthetascs.

Antenna (Fig. 7A, B) with basicerite bearing strong ventro-lateral tooth, latter reaching distal margin of first segment of antennular peduncle. Carpocerite reaching to mid-length of third segment of antennular peduncle. Scaphocerite with strong disto-lateral tooth, overreaching third segment of antennular peduncle; blade 2.2–3.0 times as long as maximum width.

Third maxilliped (Fig. 7F) slender; ultimate segment 5.3–6.6 times as long as wide at base, tapering distally; exopod exceeding distal margin of antepenultimate segment.

Major cheliped (Fig. 7G–I) with chela 4.0–4.4 times as long as maximum width, slightly compressed. Dactylus about half length to palm, compressed, somewhat twisted in dorsal view, tip rounded; plunger rather small, semi-triangular. Pollex broad at base, tip blunt, crossing with tip of dactylus.

Palm 2.5–3.2 times as long as maximum width; dorsal surface with broad transverse groove near dactylar articulation extending to lateral and mesial side by small rounded depressions, proximal shoulder small, rounded, not overhanging transverse groove; ventral margin smooth, without sculpture. Carpus short, cup-shaped. Merus 2.8–3.4 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 3 spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal margin armed with acute distal tooth; lateral surface depressed proximal to ventral side.

Minor cheliped (Fig. 8A–E) with chela 6.3–7.7 times as long as maximum width, slightly compressed. Fingers with tips acute, crossing, cutting edges sharp. Dactylus 0.8 times as long as palm, balaeniceps setae feebly developed in male, feebly developed or absent in females. Pollex without row of plumose setae in both sexes. Palm 3.3–3.6 times as long as maximum width; dorso-mesial margin with blunt subtriangular tooth flanking dactylar articulation. Carpus cup-shaped, 1.2 times as long as wide in males, 1.5 times in females. Merus 4.3–4.4 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 3 spines; ventro-lateral margin slightly protuberant, distally angular; dorsal margin with acute distal tooth; lateral surface depressed near ventral side.

Second pereopod (Fig. 8F) with chela 3.5–3.9 times as long as maximum width; fingers 1.5 times as long as palm, tips crossing, cutting edges sharp; second carpal segment 0.54–0.72 times as long as first.

Third pereopod (Fig. 8G) with dactylus simple, slightly curved, 4.4–6.2 times as long as wide at base; propodus slightly shorter than merus, ventral margin with 10–12 spines; merus 7.1–9.1 times as long as maximum width, unarmed; ischium 0.4 times length of merus, ventral margin with 1 spine. Fourth pereopod (Fig. 8H) similar to third pereopod in shape and length. Fifth pereopod (Fig. 8I) subequal in length to third

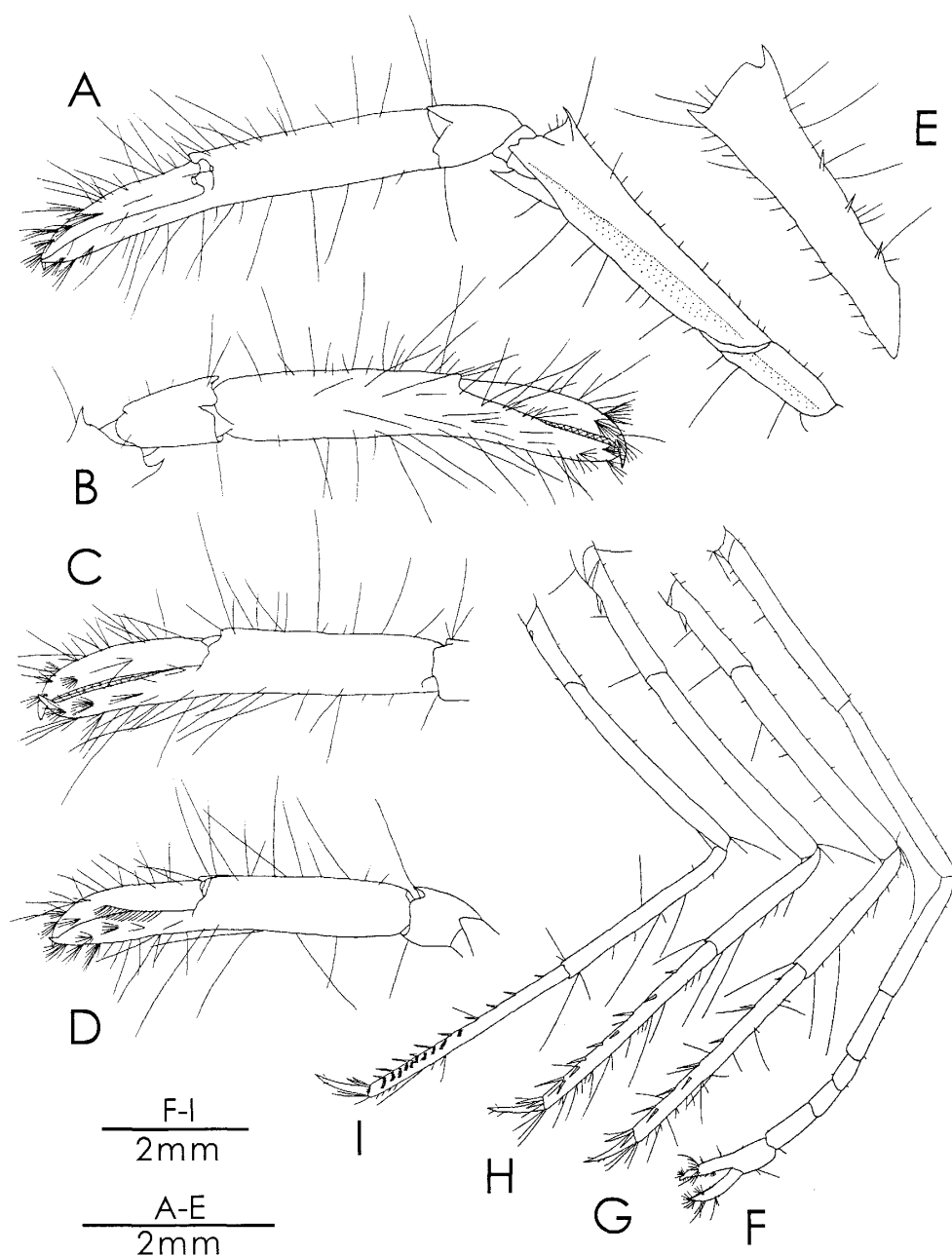


Fig. 8. *Alpheus kuroshimensis*, new species, A–C, E–I, neotype, MNHN-Na 13689, female (CL 6.1); E, paratype, NFU 530-2-2579, female (CL 5.1): A, left (minor) cheliped, dorso-lateral; B, same, chela and carpus, mesial; C, same, chela, lateral; D, left (minor) chela and carpus, lateral; E, same, merus, mesial; F, right second pereopod, lateral; G, right third pereopod, lateral; H, right fourth pereopod, lateral; I, right fifth pereopod, lateral.

pereopod; ventral margin of propodus with 11–14 spines and approximately 10 rows of tufts of short setae; ischium unarmed.

Coloration.—Ground color pale brown to red-brown; abdomen flecked with irregular whitish patches, forming broken longitudi-

nal line; lateral surface of first to fourth abdominal somite with more or less conspicuous, small black spot; palm of major chela with narrow, whitish ring proximal to dactylus (Fig. 13G, H).

Size.—Male 4.5 mm CL; largest female

6.1 mm CL, about 20 mm TL (all possibly relatively young individuals).

Habitat.—All specimens were collected under dead coral rubble on the outer reef, at a depth of about 10 m.

Distribution.—So far known only from the type locality, Kuro-shima, Yaeyama Islands, southern Ryukyu Archipelago, Japan.

Etymology.—The specific name refers to the type locality.

***Alpheus parvimaculatus*, new species**
(Figs. 9, 10, 14A–C)

New Japanese name: Buti-ashiboso-teppouebi

Alpheus gracilipes—Bruce, 1999: 462 (part).

Alpheus sp.—Baensch & Debelius, 1992: 500.

Material examined.—Holotype. Male (CL 9.2), Fuki, Kuro-shima, Yaeyama Is., southern Ryukyu Archipelago, Japan, dead coral crevices, depth 3 m, 25 May 1999, coll. K. Nomura, MNHN-Na 13766.

Paratypes. 1 female (CL 10.1), same data as for holotype, NFU 530-2-2580; 1 male (CL 8.8), same data as for holotype, SMP (YMP)-2303; 1 male (CL 9.5), 1 female (CL 9.8), same data as for holotype, CBM-6584; 1 male (CL 9.8), 1 ovig. female (CL 9.5), Kyan, Kuro-shima, dead coral crevices, intertidal reef flat, 9 Jan 1987, coll. K. Nomura, SMP (YMP)-403.

Other materials. 1 female (CL 11.3), Indonesia: probably imported from Bali, coll. F. Fasquel, 2000, MNHN-Na 13703.

Description.—Carapace (Fig. 9A, B) glabrous, anterior margin between rostrum and orbital hood slightly indented. Rostrum relatively short, rounded dorsally, 1.9–3.2 times as long as wide at base; tip reaching mid-length of visible part of first segment to 1/5 of second segment of antennular peduncle. Post-rostral area abruptly delimited from orbital hoods by deep adrostral grooves, dorsal surface almost flattened, forming with

rostrum a broad triangular plate; triangular plate 1.7–2.0 times as long as wide at base. Orbital hoods rather small, lower than rostrum and postrostral area; anterior margin bluntly projected.

Abdominal pleura (Fig. 9C) smooth, rounded; postero-ventral margin of fourth pleuron blunt, that of fifth pleuron angular. Telson (Fig. 9D) 1.6–2.0 times as long as anterior width; dorsal surface with 2 pairs of small spines, first pair arising from level just anterior to mid-length; posterior margin convex with 2 pairs of spines at postero-lateral angles, mesial spines 2.2–2.7 times as long as lateral.

Antennular peduncle (Fig. 9A, B, E) usually slightly exceeding distal margin of scaphocerite blade; first segment with small tooth on mesio-ventral carina; stylocerite distally acute, reaching nearly to 1/3 of second segment; second segment 1.5–1.8 times as long as central width, as long to 1.5 times longer as visible part of first segment. Lateral flagellum biramous; shorter branch composed of 2–3 segments with aesthetascs; proximal fused portion composed of 22–31 segments, distal 12–22 bearing aesthetascs.

Antenna (Fig. 9A, B) with basicerite bearing strong ventro-lateral tooth, latter not overreaching distal margin of first segment of antennular peduncle. Carpocerite reaching to 4/5 of third segment of antennular peduncle. Scaphocerite with strong disto-lateral tooth, reaching far beyond third segment of antennular peduncle; blade relatively broad, 2.1–2.5 times as long as maximum width.

Third maxilliped (Fig. 9F) slender; ultimate segment 5.8–6.4 times as long as proximal width, tapering distally; exopod exceeding distal margin of antepenultimate segment.

Major cheliped (Fig. 9G–J) with chela 3.8–4.5 times as long as maximum width, slightly compressed laterally. Dactylus 0.5–0.7 times as long as palm, compressed, somewhat twisted in dorsal view, tip rounded; plunger small, semi-triangular. Pollex with broad base, tip blunt, crossing with tip

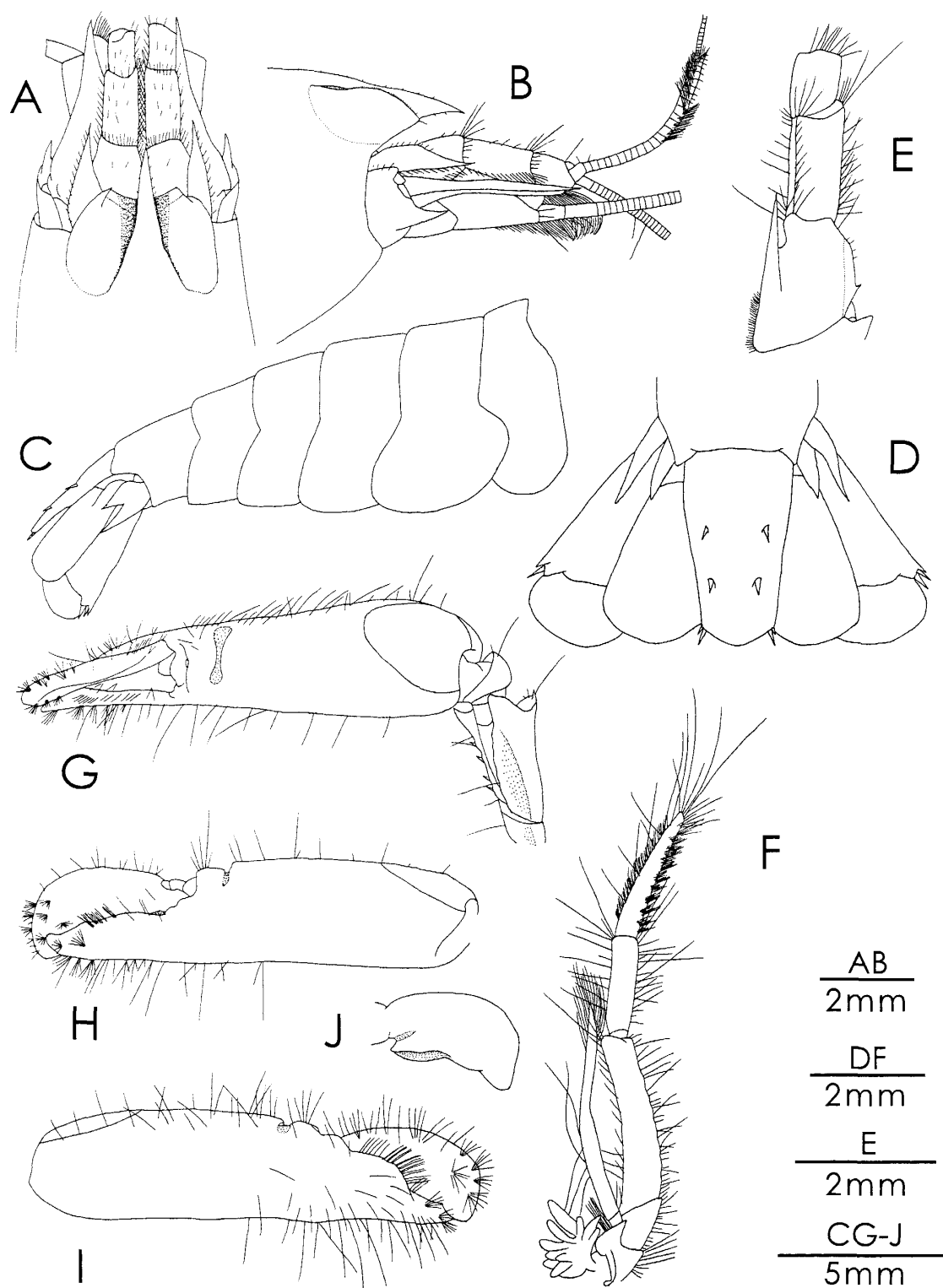


Fig. 9. *Alpheus parvimaculatus*, new species, holotype, MNHN-Na 13766, 1 male (CL 9.2): A, anterior carapace and cephalic appendages, dorsal; B, same, lateral; C, abdomen, lateral; D, telson and uropods, dorsal; E, right antennular peduncle, ventro-lateral; F, left third maxilliped, mesial; G, left (major cheliped), dorsal (merus and ischium, lateral); H, same, chela, lateral; I, same, mesial; J, same, dactylus, mesial.

of dactylus. Palm 2.3–3.0 times as long as maximum width; dorsal surface with narrow transverse groove near dactylar articulation extending to lateral and mesial side by small rounded depressions, proximal shoulder small, rounded, not overhanging transverse groove; ventral margin smooth, without sculpture. Carpus short, cup-shaped. Merus 2.4–3.8 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 2–4 spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal margin ending in acute distal tooth; lateral surface with depression along ventral side.

Minor cheliped showing slight sexual dimorphism. Male minor chela (Fig. 10A–C) slightly compressed, 5.2–5.9 times as long as wide. Fingers with tips acute, crossing, cutting edges sharp. Dactylus 0.7–0.9 times length of palm, with moderately developed balaeniceps setae. Pollex with row of plumose setae on both mesial and lateral surface. Palm 2.7–3.3 times as long as maximum width; dorso-mesial surface with blunt subtriangular tooth flanking dactylar articulation. Carpus short, cup-shaped, 1.0–1.3 times as long as wide. Merus about 4 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 2–4 spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal margin ending in acute distal tooth; lateral surface with depression proximal to ventral side. Female minor chela (Fig. 10D) 5.0–6.4 times as long as wide; dactylus with balaeniceps setae feebly developed or absent; pollex usually without row of plumose setae; carpus cup-shaped, 1.2–1.3 times as long as wide. Other features as in male.

Second pereopod (Fig. 10E) with chela 3.5–4.1 times as long as maximum width; fingers slightly longer than palm, tips crossing, cutting edges sharp; second carpal segment 0.71–0.85 times as long as first.

Third pereopod (Fig. 10F) with dactylus simple, slightly curved, 2.5–5.0 times as long as wide at base; propodus slightly shorter

than merus, ventral margin with 8–14 spines; carpus 0.6 times as long as merus; merus 6.7–8.3 times as long as maximum width, unarmed; ischium 0.4 times as long as merus, ventral margin with 1 spine. Fourth pereopod (Fig. 10G) similar to third pereopod in shape and length. Fifth pereopod (Fig. 10H) similar to third pereopod in length; ventral surface of propodus with about 15 spines and 12 rows of tufts of short setae; ischium unarmed.

Coloration.—Ground color chocolate-brown, greenish-brown or orange-brown. Dorsal surface of carapace and abdomen with numerous small, elongated, often irregularly shaped whitish or pale colored patches. First to fifth abdominal pleura each with small black spot laterally, that of second pleuron larger than others, but not forming distinct ocellus; whitish patches of abdominal somites not connecting transversally and longitudinally. Chelipeds brown-orange, with darker areas near finger bases, distal portion of dactylus of major chela whitish; second to fifth pereopods with tinge of brown-orange or orange. Tail fan brownish or orange, posterior half blue-grey (Fig. 14A–C).

Size.—Medium-sized species within *A. gracilipes* complex, with largest male measuring 9.8 mm CL; largest female 11.3 mm CL, about 36 mm TL.

Habitat.—The type specimens were collected from crevices or under large dead coral, from the intertidal zone down to 3 m deep. In some localities, the new species was found together with *A. gracilipes* and *A. roseodigitalis*, n. sp. (described below).

Distribution.—Distributed in the Indo-West Pacific: southern Japan (type locality), Indonesia and northern Australia (Bruce, 1999; present study).

Etymology.—The specific name is a combination of the Latin words, parvus (= small) and macula (= spot), in reference to characteristic color pattern, consisting of numerous small whitish patches on a brown background.

Remarks.—Bruce's (1999) record of *A.*

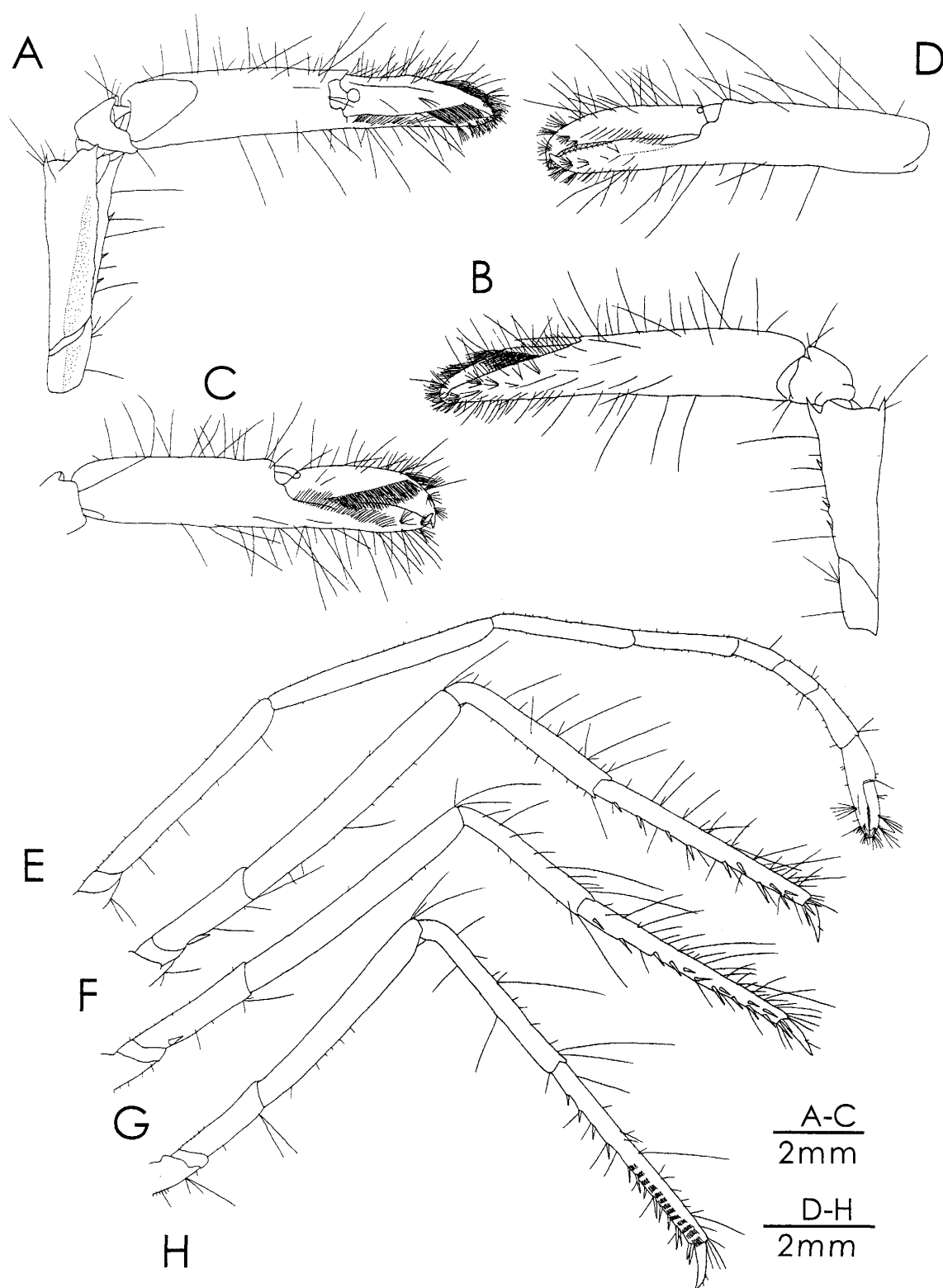


Fig. 10. *Alpheus parvimaculatus*, new species, A-C, E-H, holotype, MNHN-Na 13766, male (CL 9.2); D, paratype, CBM-6584, female (CL 9.8): A, right (minor) cheliped, dorso-lateral; B, same, mesial; C, same, chela, lateral; D, left (minor) chela, lateral; E, right second pereopod, lateral; F, right third pereopod, lateral; G, right fourth pereopod, lateral; H, right fifth pereopod, lateral.

gracilipes from Australia is problematical. His description of *A. gracilipes* from Western Australia is most likely based on features of several species. For example, a relatively short rostrum, larger and higher orbital hoods and longer carpocerite of the antenna (Bruce, 1999; Fig. 4 A) are characteristic to *A. gracilipes*; a broader postrostral area (Fig. 4A, B) is characteristic to *A. angustilineatus*, n. sp.; and a broader scaphocerite blade is rather typical to *A. parvimaculatus*, n. sp. (Fig. 4, C). On the other hand, the color pattern of a specimen from Darwin, Northern Territory (Bruce, 1999, p. 462), is typical to *A. parvimaculatus*, n. sp., confirming its presence in northern Australia.

***Alpheus roseodigitalis*, new species**
(Figs. 10, 11, 14D–F)

Japanese name: Ashiboso-teppouebi

Alpheus gracilipes—Kamezaki *et al.*, 1988: 57 with unnumbered fig.; Miyake, 1991, pl. 15-3; Nomura *et al.*, 1996: 11.

Material examined. —Holotype. Male (CL 5.7), Aragusuku-jima, Yaeyama Islands, southern Ryukyu Archipelago, Japan, dead coral crevices, intertidal, 13 Jul 1999, coll. K. Nomura, MNHN-Na 13761.

Paratypes. Yaeyama Islands, southern Ryukyu Archipelago: 1 female (CL 6.9), same data as for holotype, MNHN-Na 13634; 1 male (CL 5.3), Fuki, Kuro-shima, dead coral crevices, intertidal, 30 Nov 1986, coll. K. Nomura, SMP (YMP)-350; 3 males (CL 6.1–7.0), Fuki Kuro-shima, dead coral crevices, depth 3 m, 21 Mar 1988, coll. K. Nomura, CBM-ZC 6585; male (CL 3.8), 1 ovig. female (CL 5.7), same locality as for CBM-ZC 6585, 3 Sep 1998, coll. K. Nomura, SMP (YMP)-2089; 1 males (CL 5.5), 1 ovig. female (CL 5.7), same data as for SMP-2089, SMP (YMP)-2090; 1 ovig. female (CL 6.4), Iko, Kuro-shima, dead coral crevices, depth 5 m, 27 Nov 1987, coll. K. Nomura, SMP (YMP)-782a. Okinawa Islands, central Ryukyu Archipelago: 1 ovig. female (CL 5.5),

Nishihama, Aka-jima, dead coral crevices, depth 10 m, 4 Jul 1992, coll. K. Nomura, SMP (YMP)-966; 1 male (CL 6.9), 1 ovig. (CL 5.6), Yakabi-jima, dead coral crevices, intertidal, 23 Apr 1994, coll. K. Nomura, SMP (YMP)-1238b; 1 male (CL 6.5), 1 female (CL 7.3), Yakabi-jima, dead coral crevices, depth 10 m, 24 Apr 1994, coll. K. Nomura, NFU 530-2-2581; 1 male (CL 4.6), Shimajiri, Kume-jima, depth 1–3 m, 18 Nov 1992, coll. S. Nagai, SMP (YMP)-1223b; 1 ovig. female (CL 4.3), Ahra, Kume-jima, dead coral crevices, intertidal, 13 Jun 1995, coll. K. Nomura, SMP (YMP)-1383; 1 male (CL 5.5), 1 ovig. female (CL 6.6), same locality as for SMP (YMP)-1383, 14 Jun 1995, coll. K. Nomura, SMP (YMP)-1429.

Other material. Taiwan: 15 specimens (CL of largest ovig. female 6.9), Kenting, reef near shore, from dead corals and rocks with living coral, depth 3 m, 3–4 Oct 2004, coll. A. Anker *et al.*, AS. Madagascar: 1 male (CL 5.0), 1 ovig. female (CL 5.2), Tuléar, MNHN-Na 2460. Mauritius: 1 male (CL 4.6), MNHN-Na 5821. Seychelles: 2 males (CL 4.6–4.8), 1 ovig. female (CL 7.8), Coetivy Island, MNHN-Na 2465. Chagos Islands: 1 male (CL 4.6), 1 female (CL 4.5), Egmont Island, MNHN-Na 2462; 1 male (CL 4.6), 1 female (CL 4.7), Salomon Island, MNHN-Na 2467. Maldives: 1 male (CL 4.1), 2 ovig. females (CL 5.5–5.7), South Male Atoll, Vadoo, dead coral crevices, intertidal, 18 Apr 1996, coll. K. Nomura, SMP (MD)-26.

Description.—Carapace (Fig. 11A, B) glabrous. Frontal margin between rostrum and orbital hood slightly indented in dorsal aspect. Rostrum broad, relatively short, 1.1–2.8 times as long as wide at base; tip reaching distal margin of first segment to mid-length of second segment of antennular peduncle; anterior half dorsally rounded, posterior half flattened. Post-rostral area abruptly delimited from orbital hoods by deep adrostral grooves, dorsal surface with shallow median depression, forming with rostrum a broad triangular plate; triangular plate 1.6–2.0 times as long as wide at base.

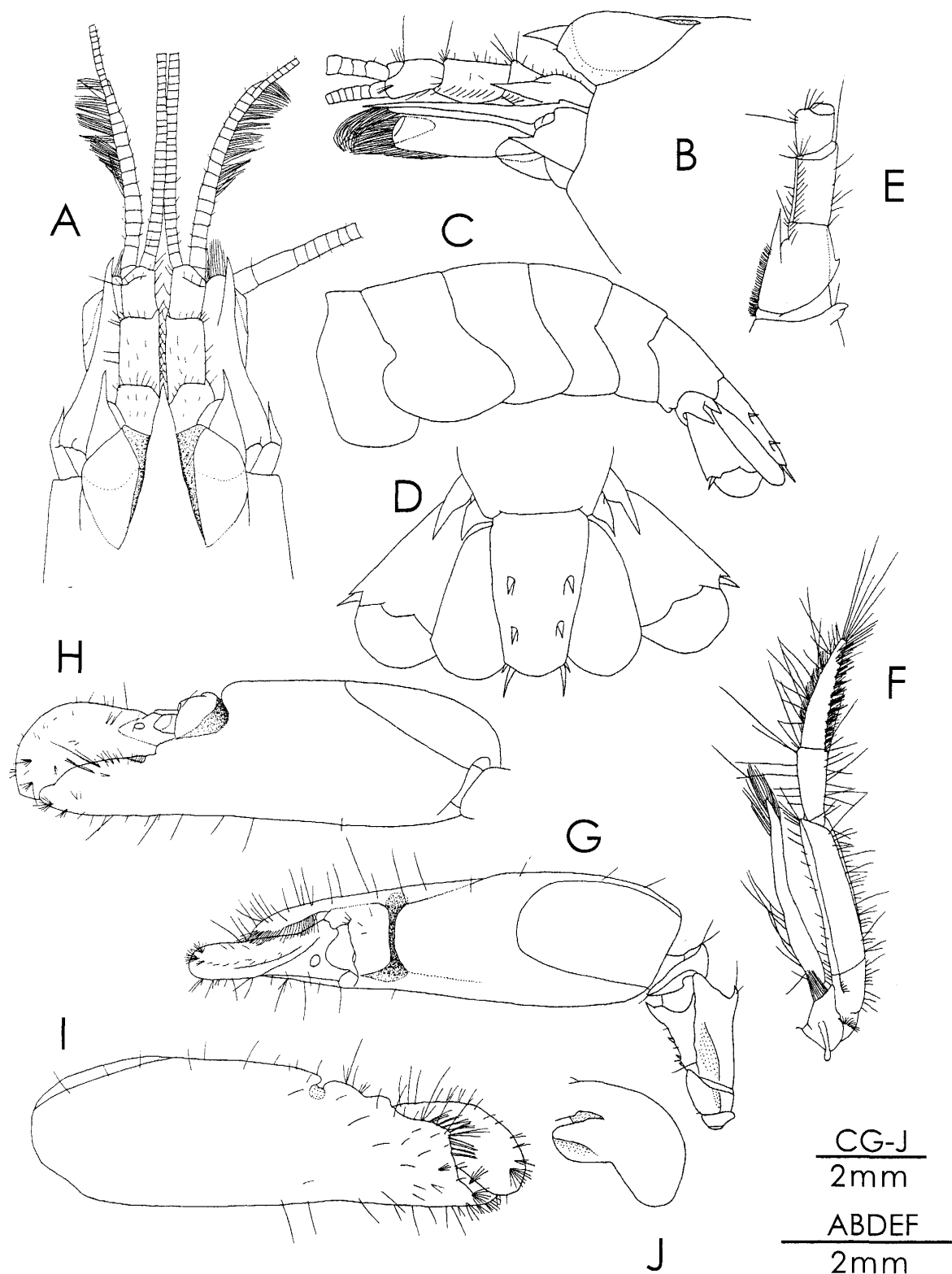


Fig. 11. *Alpheus roseodigitalis*, new species, holotype, MNHN-Na 13761, male (CL 5.7): A, anterior carapace and cephalic appendages, dorsal; B, same, lateral; C, abdomen, lateral; D, telson and uropods, dorsal; E, right antennular peduncle, ventro-lateral; F, left third maxilliped, mesial; G, left (major) cheliped, dorsal (merus and ischium, lateral); H, same, chela, lateral; I, same, mesial; J, same, dactylus, mesial.

Orbital hoods inflated, higher than rostrum and post-rostral area; anterior margin slightly angular.

Abdominal pleura (Fig. 11C) smooth, rounded; postero-ventral margin of fourth pleuron rounded, that of fifth pleuron blunt. Telson (Fig. 11D) 1.6–2.0 times as long as anterior width; dorsal surface with 2 pairs of moderately strong spines, first pair arising anterior to mid-length; posterior margin convex, with 2 pairs of spines at postero-lateral angles, mesial spine very long, 2.7–4.0 times as long as lateral.

Antennular peduncle (Fig. 11A, B, E) usually slightly exceeding distal margin of scaphocerite blade; first segment with small tooth on mesio-ventral carina; stylocerite distally pointed, reaching about 1/3 of second segment; second segment 1.5–1.8 times as long as central width, 1.0–1.5 times as long as visible part of first segment. Lateral flagellum biramous; shorter branch usually composed of 3 segments with aesthetascs; proximal fused portion composed of 10–20 segments, distal 5–15 bearing aesthetascs.

Antenna (Fig. 11A, B) with basicerite bearing strong ventro-lateral tooth, latter not reaching distal margin of first segment of antennular peduncle. Carpocerite reaching mid-length of second segment to distal margin of third segment of antennular peduncle. Scaphocerite with strong disto-lateral tooth, reaching far beyond third segment of antennular peduncle; blade broad, 2.1–2.3 times as long as maximum width.

Third maxilliped (Fig. 11F) slender; ultimate segment 4.7–5.6 times as long as wide at base, tapering distally; exopod overreaching distal margin of antepenultimate segment.

All pereopods relatively stout. Chelipeds showing slight sexual dimorphism, chelae of males being more robust than those of females. Major cheliped (Fig. 11G–J) with chela 3.0–3.5 times as long as maximum width in males, 3.1–3.6 times in females, slightly compressed. Dactylus about half length of palm, compressed, somewhat twisted in dorsal view, tip rounded; plunger

stout, semi-rectangular. Pollex with broad base, tip blunt, crossing with tip of dactylus. Palm 2.1–2.4 times as long as maximum width; dorsal surface with deep, narrow transverse groove near dactylar articulation extending to lateral and mesial side by oval to rounded depressions, proximal shoulder small, rounded, slightly overhanging transverse groove; ventral margin smooth, without sculpture. Carpus short, cup-shaped. Merus 2.3–2.9 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 2–3 spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal margin with acute distal tooth; lateral surface with depression near ventral side.

Male minor cheliped (Fig. 12A–C) with chela 4.4–5.3 times as long as maximum width, slightly compressed. Fingers with tips acute, crossing, cutting edges sharp. Dactylus 0.8 times as long as palm, with moderately developed balaeniceps setae. Pollex with row of plumose setae on mesial and lateral surface. Palm 2.5–2.7 times as long as maximum width; dorso-mesial margin with blunt subtriangular tooth flanking dactylar articulation. Carpus short, cup-shaped, almost as long as wide. Merus 3.5–4.0 times as long as distal width; ventral surface shallowly excavated; ventro-mesial margin with acute distal tooth and 1–3 (usually 2) spines; ventro-lateral margin slightly protuberant, distally unarmed; dorsal margin armed with acute distal tooth; lateral surface with depression on ventral half. Female minor cheliped with chela (Fig. 12D) 4.8–5.3 times as long as maximum width. Dactylus usually without balaeniceps setae; pollex without row of plumose setae; carpus cup-shaped, slightly longer than wide. Other features as in male.

Second pereopod (Fig. 12E) with chela 3.3–4.3 times as long as maximum width; fingers about 1.3 times as long as palm, tips crossing, cutting edges sharp; second carpal segment 0.71–0.89 times as long as first.

Third pereopod (Fig. 12F) with dactylus simple, slightly curved, 3.8–4.5 times as long

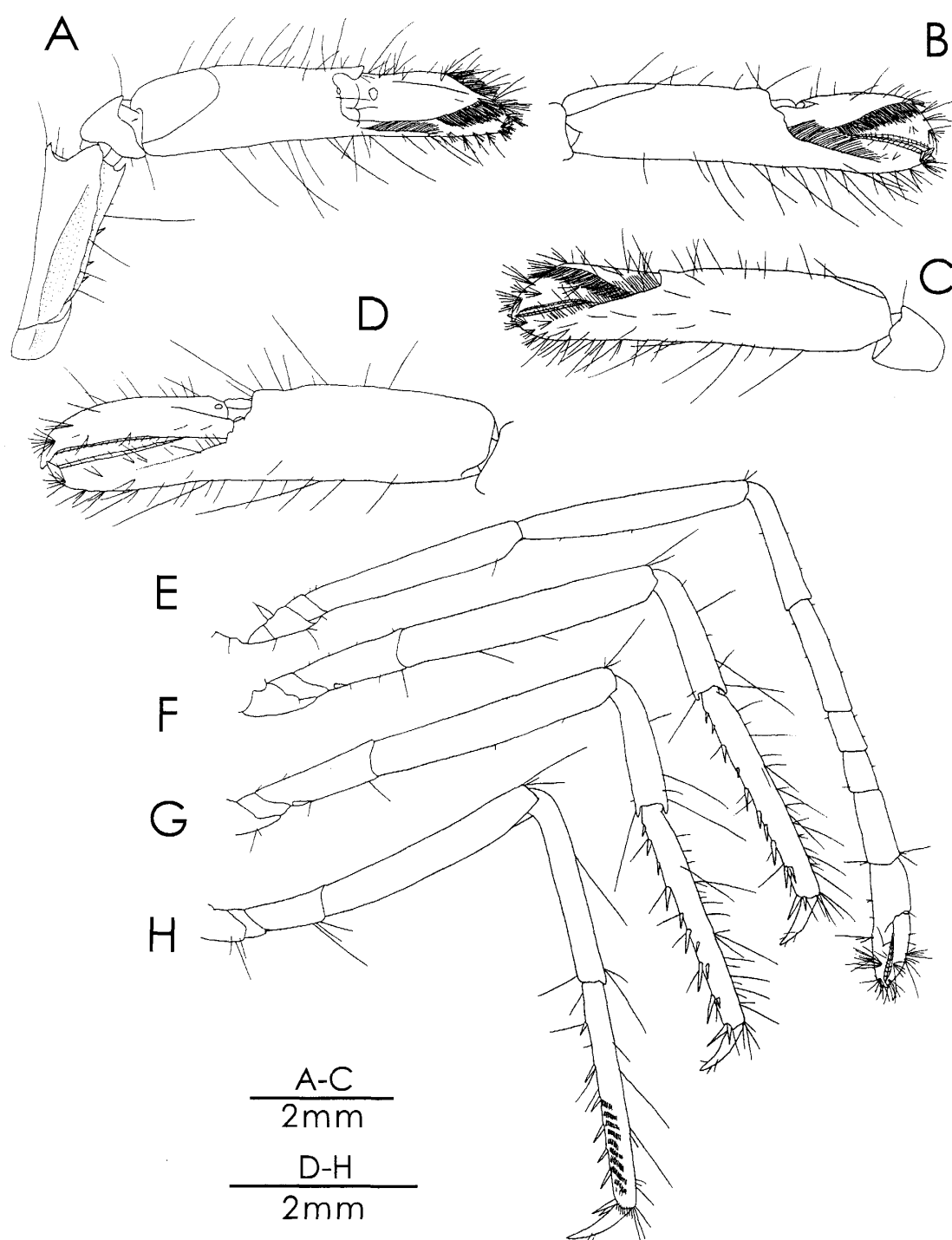


Fig. 12. *Alpheus roseodigitalis*, new species, A-C, E-G, holotype, MNHN-Na 13761, male (CL 5.7); D, H, paratype, MNHN-Na 13634, female (CL 6.9): A, right (minor) cheliped, dorso-lateral; B, same, chela, lateral; C, same, chela and carpus, mesial; D, left (minor) chela, lateral; E, right second pereopod, lateral; F, right third pereopod, lateral; G, right fourth pereopod, lateral; H, right fifth pereopod, lateral.

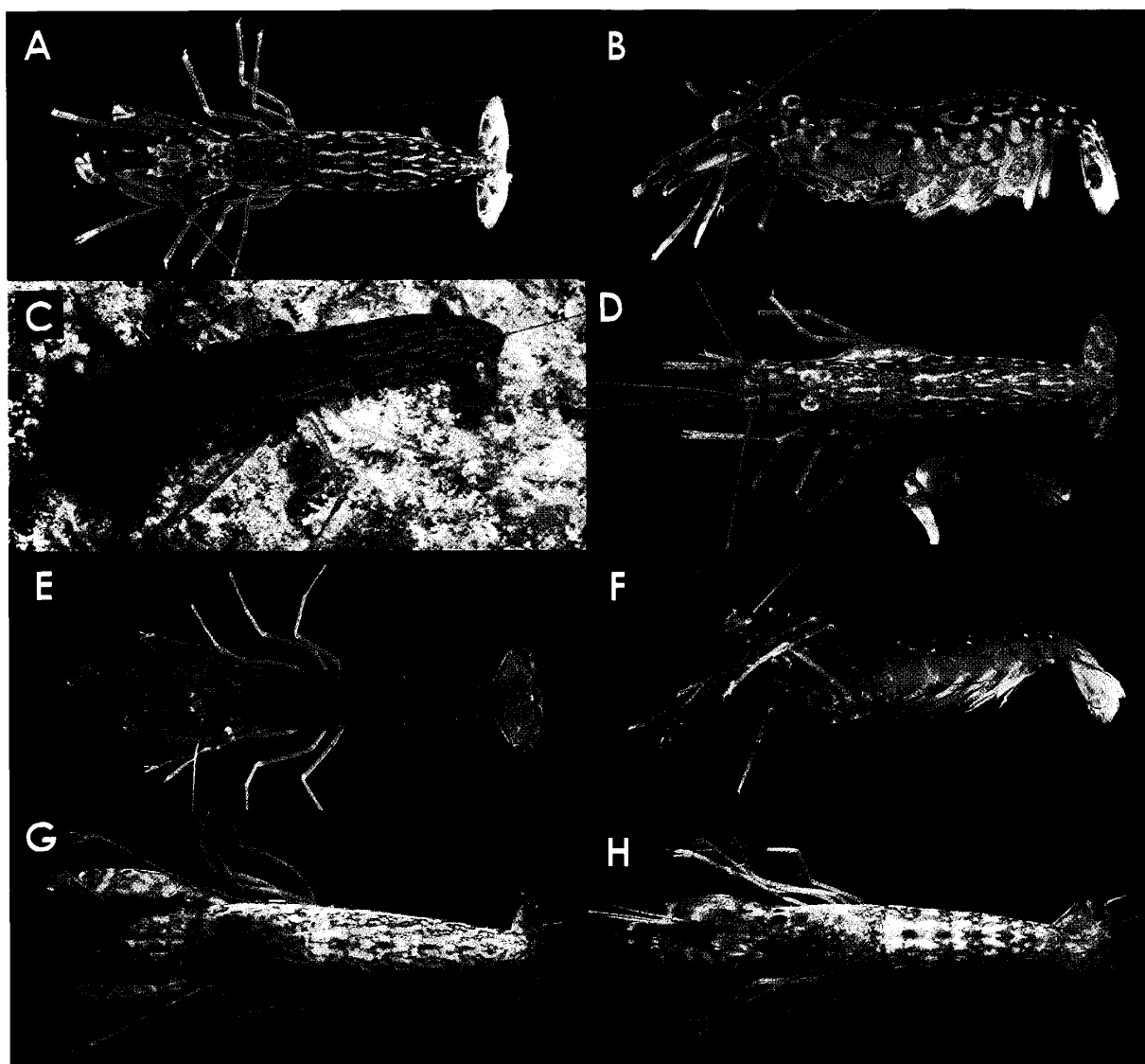


Fig. 13. A, B, *Alpheus gracilipes* Stimpson, ovig. female (MNHN-Na 13660, CL 7.4), Okinawa; C, *A. angustilineatus*, new species, holotype male (MNHN-Na 13760, CL 5.3), Yaeyama; D, *A. angustilineatus*, new species, male (LACM CR 2005-005, CL 17.1), Fiji; E, *A. fujitai*, new species, holotype male (MNHN-Na 13644, CL 17.4), Okinawa; F, *A. fujitai*, new species, paratype female (NFU 530-2-2577, CL 19.8), Okinawa; G, *A. kuroshimensis*, new species, holotype female (MNHN-Na 13689, CL 6.1), Yaeyama; H, *A. kuroshimensis*, new species, paratype female (NFU 530-2-2579, CL 5.1), Yaeyama. Photos by Y. Fujita (A, B, E, F), A. Anker (D) and K. Nomura (C, G, H).

as wide at base; propodus slightly shorter than merus, ventral margin with 9–13 spines; merus 5.4–6.7 times as long as maximum width, unarmed; ischium 0.4 times length of merus, ventral surface with 1 spine. Fourth pereopod (Fig. 12G) similar to third pereopod in shape and length. Fifth pereopod (Fig. 12H) similar to third pereopod in length; ventral surface of propodus

with about 8 spines and 10 rows of tufts of short setae; ischium unarmed.

Coloration.—Ground color greenish-brown to olive-brown; dorsal surface of carapace and abdomen with numerous elongated, irregular white patches or spots of different size; first to fifth abdominal pleura each with one small black spot laterally, that on second pleuron comparatively larger, but

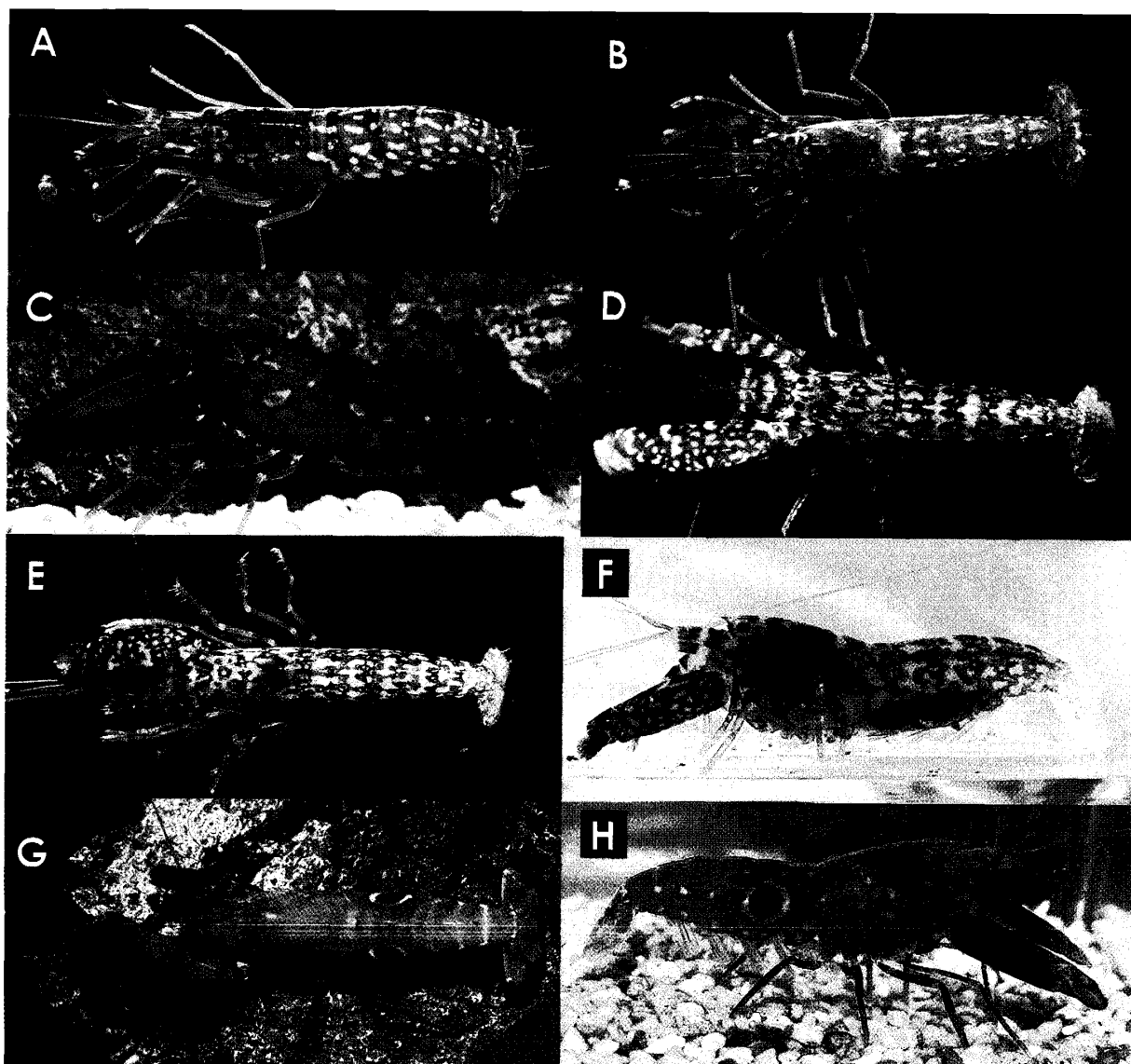


Fig. 14. A, *Alpheus parvimaculatus*, new species, holotype male (MNHN-Na 13766, CL 9.2), Yaeyama; B, *A. parvimaculatus*, new species, paratype female (NFU 530-2-2580, CL 10.1), Yaeyama; C, *A. parvimaculatus*, new species, specimen probably imported from Bali; D, *A. roseodigitalis*, new species, paratype male (NFU 530-2-2581, CL 6.5), Yaeyama; E, *A. roseodigitalis*, new species, ovig. female (SMP-MD-26, CL 5.7), Maldives; F, *A. roseodigitalis*, new species, female (AS), Taiwan; G, *A. soror* Bruce, female (CL 11.6), Sri Lanka; H, *A. soror* Bruce, female, specimen probably imported from Sri Lanka. Photos by K. Nomura (A, B, D, E), F. Fasquel (C, G), H.-C. Liu & A. Anker (F) and R. Baur-Kruppas (H).

not forming ocellus (not fringed by white circle), whitish patches of each abdominal segment usually connecting transversally, but not longitudinally; major chela greenish to olive, with numerous irregular white patches and spots, distal portion of fingers, especially dactylus, bright purple-pink, finger tips whitish; second to fifth pereopods blue-pur-

ple to light brown; tail fan greenish with whitish or blue patches (Fig. 14D-F).

Size.—Small-sized species within *A. gracilipes* complex, with largest male measuring 7.0 mm CL; largest female 7.8 mm CL, approximately 25 mm TL.

Habitat.—All Japanese specimens were collected from crevices in large dead coral in

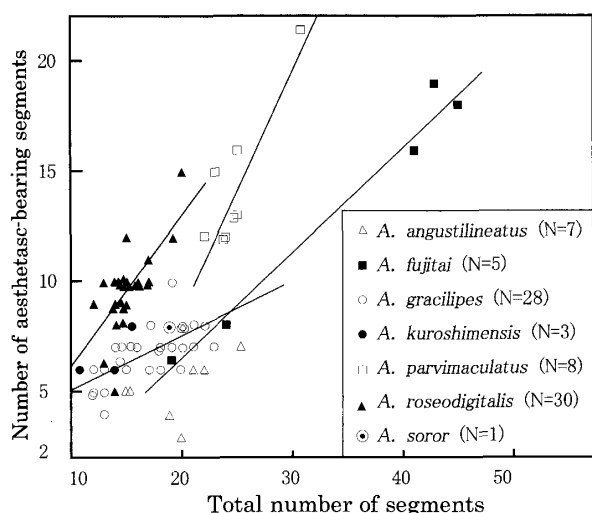


Fig. 15. Relationship between the total number of segments and number of aesthetasc-bearing segments on the proximal fused portion of the lateral antennular flagellum for seven species of the *Alpheus gracilipes* complex. Regression lines appear in four species: *A. fujitai*, new species, *A. gracilipes* Stimpson, *A. parvimaculatus*, new species, and *A. roseodigitalis*, new species.

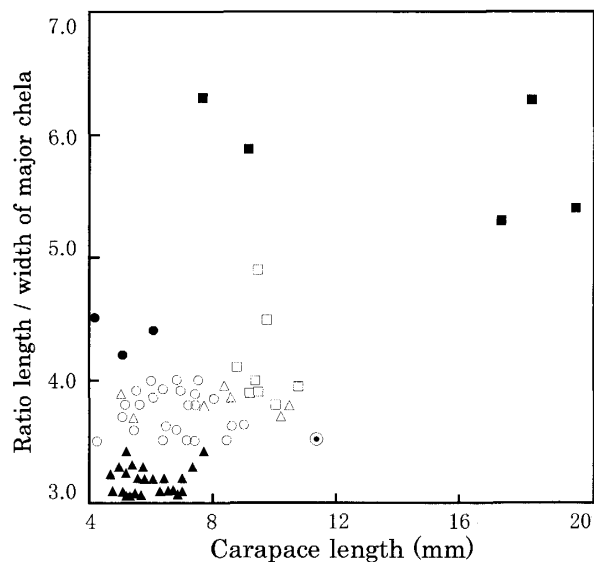


Fig. 16. Relationship between the carapace length and the length / width ratio of the major chela for seven species of the *Alpheus gracilipes* complex. Symbols are same as in Fig. 15.

depths ranging from the intertidal down to 10 m. The Taiwanese specimens were collected by breaking coral rubble and rocks overgrown with living corals and algae, at

about 3 m, near the reef shore.

Distribution.—Widely distributed in the Indo-West Pacific: presently known from southern Japan (type locality), Taiwan, Madagascar, Chagos Islands, Seychelles, Mauritius, Maldives. This species is the most common species of the *A. gracilipes* complex in Japan and Taiwan.

Etymology.—The specific name is a combination of the Latin words, *rosa* (= pink) and *digitus* (= finger), referring to the characteristic pink color of the major chela fingers.

Remarks. — The probability that the new species was previously mistaken for *A. gracilipes* is relatively high. For instance, the Japanese specimens identified as *A. gracilipes* by Kamezaki *et al.* (1988), Miyake (1991) and Nomura *et al.* (1996) actually all refer to the new species. The specimens from the Maldives agree quite well with the Japanese specimens in both morphology and coloration (Fig. 14C, D), the only notable exception being a weaker development of the balaeniceps setae in one of the two ovigerous females from the Maldives.

Discussion

Distinction of species within the Alpheus gracilipes complex

The *A. gracilipes* complex presently includes seven species: *A. angustilineatus*, *A. fujitai*, *A. gracilipes*, *A. kuroshimensis*, *A. parvimaculatus*, *A. roseodigitalis* and *A. soror*. In life these species can be easily separated by species-characteristic color patterns (Fig. 13, 14). However, preserved specimens can be identified correctly only by a combination of several subtle morphological features. The diagnostic characters enabling a discrimination of the presently known seven species of the *A. gracilipes* complex are summarized in Table 1. The most important of these characters are briefly discussed below.

1. Proportions of the rostrum: The rostrum is relatively more slender in *A. fujitai* and *A. kuroshimensis* compared to *A.*

roseodigitalis and *A. soror* (about 4 times as long as wide at base versus about twice).

2. Height of the orbital hood relative to the rostrum: The orbital hoods are always lower than the rostrum and post-rostral area in *A. fujitai*, *A. parvimaculatus* and *A. soror*, always higher in *A. gracilipes* and *A. roseodigitalis*, and usually higher in *A. kuroshimensis*.

3. Ratio of the total number of segments to the number of aesthetascs-bearing segments in the proximal fused portion of the lateral antennular flagellum (T/A ratio): The T/A average ratio differs among the species; 0.25 in *A. angustilineatus*, 0.40 in *A. fujitai*, *A. gracilipes* and *A. soror*, 0.50 in *A. kuroshimensis*, 0.57 in *A. parvimaculatus*, and 0.64 in *A. roseodigitalis*. Significant differences (using the covariance analysis, $P < 0.001$) were observed among four species; *A. fujitai*, *A. gracilipes*, *A. parvimaculatus* and *A. roseodigitalis* (Fig. 15).

4. Length of the carpocerite: The carpocerite usually does not overreach the second segment of the antennular peduncle in *A. angustilineatus* and *A. fujitai*, whereas it usually reaches far beyond this segment in the other five species.

5. Length / width proportions of the major chela: The average ratio differs among the seven species; 3.2 in *A. roseodigitalis*, 3.5 in *A. soror*, 3.8 in *A. angustilineatus* and *A. gracilipes*, 4.1 in *A. parvimaculatus*, 4.2 in *A. kuroshimensis*, and 5.8 in *A. fujitai* (Fig. 17). The relationship between the carapace length and the length / width ratio of the major chela is shown in Fig. 16. Graph plots of most species present a particular distribution pattern.

6. Development of the balaeniceps setae on female minor chela: The balaeniceps setae are always present in *A. angustilineatus*, *A. gracilipes* and *A. soror*, but are underdeveloped or absent in *A. fujitai*, *A. kuroshimensis*, *A. parvimaculatus* and *A. roseodigitalis*.

7. Proportion of the carpus of the female minor cheliped: The carpus is distinctly longer than wide in *A. fujitai* and *A. kuroshi-*

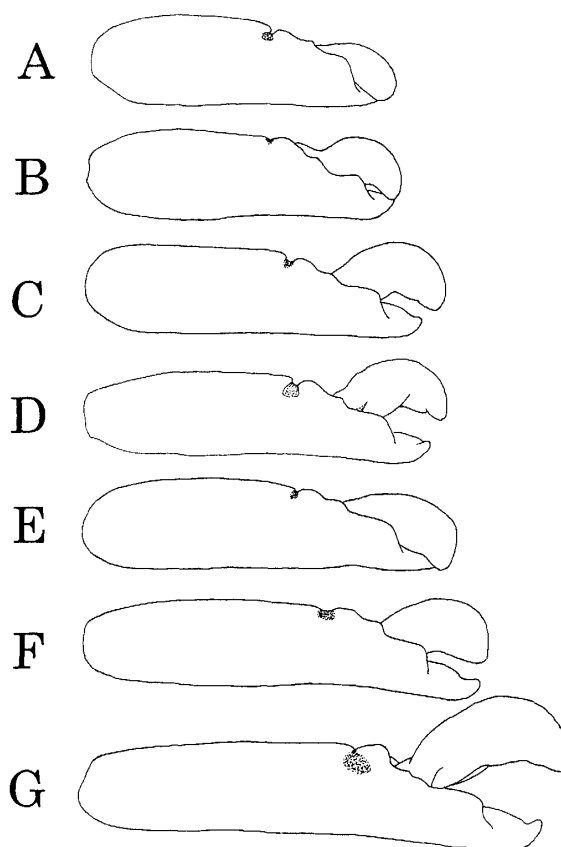


Fig. 17. Schematic illustration of typical proportions of the major chela (in mesial view) in seven species of the *Alpheus gracilipes* complex: A, *A. roseodigitalis*, new species; B, *A. soror* Bruce; C, *A. gracilipes* Stimpson; D, *A. angustilineatus*, new species; E, *A. parvimaculatus*, new species; F, *A. kuroshimensis*, new species; G, *A. fujitai*, new species.

mensis, whereas it is only slightly longer or subequal to the width in the other five species.

8. Length / width proportions of the merus of the third pereopod: This ratio is represented the general proportions of the third to fifth pereopods. *Alpheus fujitai* can be immediately separated from the other species by its very slender merus, in average 12 times as long as wide. In other species, the merus is in average 7–8 times as long as wide in *A. angustilineatus*, *A. gracilipes*, *A. kuroshimensis* and *A. parvimaculatus*, 6 times in *A. roseodigitalis* and *A. soror*.

In conclusion, each of these seven species may be separated from the other

Table 1. Comparison of the morphological characters of *Alpheus gracilipes* complex

Characters	Species						
	<i>A. angusti-</i> <i>lineatus</i> n.sp.	<i>A. fujitai</i> n.sp.	<i>A. gracilipes</i>	<i>A. kuroshim-</i> <i>ensis</i> n.sp.	<i>A. parvimacu-</i> <i>latus</i> n.sp.	<i>A. roseo-</i> <i>digitalis</i> n.sp.	<i>A. soror</i> ¹⁾
Number of specimens examined	7	5	28	3	8	30	2
Carapace length of largest specimen (mm)	10.8	19.8	8.6	6.1	11.3	7.8	15.0
Rostrum (dorsal view)							
Average ratio (range) of length to proximal width	3.4(2.4-4.0)	4.0(3.4-4.7)	2.5(1.9-3.1)	3.9(3.6-4.2)	2.7(1.9-3.2)	2.0(1.1-2.8)	1.9
Approximate tip reaching point to antennular peduncle	1/3 of 2nd	1/2 of 2nd	tip of 1st	1/5 of 2nd	tip of 1st	tip of 1st	1/2 of 2nd
Postrostral area including rostrum (dorsal view)							
Average ratio of length to proximal width	1.9	2.4	2.0	2.4	1.8	2.0	1.5
Orbital hood (lateral view)							
Height against rostrum and postrostral area		lower	higher	usually higher	lower	higher	lower
Postero-lateral spines of telson							
Average ratio (range) of mesial spine length / lateral spine length	3.3(2.5-4.5)	2.8(2.4-3.4)	3.2(2.5-3.8)	3.0(2.9-3.2)	2.4(2.2-2.7)	3.2(2.7-4.0)	2.4
Proximal fused portion of lateral antennular flagellum							
Average ratio (range) of number of aesthetasc-bearing segment / total number of segment	0.25(0.15-0.3)	0.4(0.33-0.45)	0.4(0.3-0.5)	0.5(0.43-0.55)	0.57(0.5-0.71)	0.64(0.4-0.8)	0.40
Carpocerite							
Approximate tip reaching point to antennular peduncle	tip of 2nd	tip of 2nd	1/2 of 3rd	1/2 of 3rd	3/5 of 3rd	tip of 3rd	3/5 of 3rd
Scaphocerite blade							
Average ratio of length to maximum width	2.7	2.4	2.6	2.7	2.3	2.2	2.0
Major chela							
Average ratio (range) of length / width	3.8(3.6-4.0)	5.8(5.3-6.3)	3.8(3.5-4.5)	4.2(4.0-4.4)	4.1(3.8-4.5)	3.2(3.0-3.5)	3.5(3.4-3.5)
Minor chela							
Average ratio (range) of length / width	5.3(4.8-6.0)	7.3(6.0-8.3)	5.1(4.6-5.9)	6.8(6.3-7.7)	5.6(5.0-6.4)	4.9(4.4-5.3)	4.8(4.7-4.8)
Balaniceps of dactylus in females ²⁾	○	△	○	△ or ×	△ or ×	×	○
Average ratio (range) of length / width of carpus in females	1.2(1.1-1.3)	1.5(1.3-1.6)	1.0(0.9-1.2)	1.5	1.3(1.2-1.3)	1.2	1.1
Merus of third pereiopod							
Average ratio (range) of length / width	7.5(6.7-8.3)	11.9(11.0-12.5)	7.1(6.3-7.7)	8.4(7.1-9.1)	7.6(6.7-8.3)	6.1(5.4-6.7)	6.0(5.9-6.0)

¹⁾ including Bruce (1988) ²⁾ ×: absent, △: weakly developed, ○: moderately developed

species by a unique combination of several features: *A. angustilineatus* is diagnosed by the lower T/A ratio (see above paragraph), shorter carpocerite, rather slender pereiopods, female minor cheliped with well developed balaeniceps setae and shorter carpus; *A. fujitai* by a slender rostrum, lower orbital hoods, lower T/A ratio, shorter carpocerite, very slender pereiopods, female minor cheliped with underdeveloped or without balaeniceps setae and longer carpus; *A. gracilipes* by the higher orbital hood, lower T/A ratio, longer carpocerite, rather slender pereiopods, female minor cheliped with well developed balaeniceps setae and shorter carpus; *A. kuroshimensis* by a slender rostrum, longer carpocerite, rather slender pereiopods, female minor cheliped with underdeveloped or lacking balaeniceps setae and longer carpus; *A. parvimaculatus* by the lower orbital hoods, higher T/A ratio, longer carpocerite, rather slender pereiopods, female minor cheliped with underdeveloped or without balaeniceps setae and shorter carpus; *A. roseodigitalis* by a broader and shorter rostrum, higher orbital hoods, higher T/A ratio, longer carpocerite, stouter pereiopods, minor female cheliped usually lacking balaeniceps setae and shorter carpus; *A. soror* by a broader rostrum, lower T/A ratio, longer carpocerite, stouter pereiopods, female minor cheliped with well developed balaeniceps setae and shorter carpus.

Keys to the species of the *Alpheus gracilipes* complex

Two keys to the seven presently known species of the *A. gracilipes* complex, based on morphological features and color patterns, respectively, are provided below.

I. Morphological key

- 1 Major chela about 6 times as long as wide; merus of third pereiopod about 12 times as long as wide *Alpheus fujitai*
- Major chela 3–4 times as long as wide, merus of third pereiopod less than 9 times as long as wide 2

- 2 Ratio of total number of segments / number of aesthetascs bearing segments on proximal fused portion of lateral antennular flagellum usually less than 0.3; carpocerite short, not exceeding second segment of antennular peduncle *Alpheus angustilineatus*
- Ratio of total number of segments / number of aesthetascs bearing segments on proximal fused portion of lateral antennular flagellum more than 0.3; carpocerite long, well exceeding second segment of antennular peduncle 3
- 3 Scaphocerite blade less than 2.5 times as long as wide 4
- Scaphocerite blade about 2.7 times as long as wide 6
- 4 Orbital hoods higher than rostrum and post-rostral area *Alpheus roseodigitalis*
- Orbital hoods lower than rostrum and postrostral area 5
- 5 Major chela about 3.5 times as long as wide; merus of third pereiopod about 6 times as long as wide *Alpheus soror*
- Major chela about 4 times as long as wide; merus of third pereiopod 7–8 times as long as wide *Alpheus parvimaculatus*
- 6 Rostrum about 4 times as long as wide at base; carpus of female minor cheliped 1.5 times as long as wide *Alpheus kuroshimensis*
- Rostrum about 2.5 times as long as wide at base; carpus of female minor cheliped 0.9–1.2 times as long as wide *Alpheus gracilipes*

II. Color pattern key

- 1 Ground color uniform brown, without whitish patches or dark spots *Alpheus fujitai*
- Ground color orange, brown or greenish with matrix of whitish patches, usually with small or larger dark spots 2
- 2 Second abdominal pleuron laterally with very conspicuous large eye spot or ocellus 3
- Second abdominal somite without conspicuous ocellus 4
- 3 Ground color orange, both major and

- minor chela distally purplish; ocellus bordered by deep and pale orange circles.....
*Alpheus soror*
- Ground color pale to dark brown, both major and minor chelae brown; ocellus not doubled by orange circle.....
*Alpheus gracilipes*
- 4 Tip of fingers of major chela bright pink
 *Alpheus roseodigitalis*
- Tip of fingers of major chela not pinkish5
- 5 Whitish patches of each abdominal somite not connected longitudinally or transversally on several somites; major chela usually without whitish patch
*Alpheus parvimaculatus*
- Abdominal whitish patches connected longitudinally or transversally on several somites; major chela with whitish or pale patches.....6
- 6 Abdominal patches rather large, connected both longitudinally and transversally
*Alpheus kuroshimensis*
- Abdominal patches narrow, connected only longitudinally
*Alpheus angustilineatus*

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